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CLINICAL DIAGNOSIS:

A HANDBOOK

FOR

STUDENTS AND PRACTITIONERS OF MEDICINE.

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EDITED BY

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On THE PHYSIOGNOMY OF DISEASE.

JAMES FINLAYSON, M.D., Physician and Lecturer on Clinical Medicine in the Glasgow Western Infirmary, &c.

On CASE-TAKING, Family History, &c.
On SYMPTOMS OF DISORDER IN THE VARIOUS SYSTEMS.
(Except in so far as specified below.)

WILLIAM STEPHENSON, M.D., Regius Professor of Midwifery in the University of Aberdeen.

On DISORDERS OF THE FEMALE ORGANS.

ALEXANDER ROBERTSON, M.D., Physician and Superintendent of the Town's Hospital and City Parochial Asylum, Glasgow.

On INSANITY.

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On THE SPHYGMOGRAPH.
On THE PHYSICAL EXAMINATION OF THE CHEST AND ABDOMEN.

JOSEPH COATS, M.D., Pathologist and Lecturer on Pathology in the Glasgow Western Infirmary, and also Physician to the Dispensary and its Throat Department.

On THE EXAMINATION OF THE FAUCES, LARYNX, AND NARES.
On THE METHOD OF PERFORMING POST-MORTEM EXAMINATIONS.

PREFACE.

WHILE engaged in assisting Professor Gairdner in conducting his Clinical Classes in the Glasgow Royal Infirmary, and also in my own work at the Western Infirmary here, the want has often been felt of some volume to which students might be referred for assistance in the study and reporting of medical cases. The methods of case-taking sketched out by various teachers are no doubt useful in their way; but they do not give the amount or the kind of assistance really required in the investigation of a difficult case.

It is common to find that at the bedside of a patient the observer fails to apply the knowledge he actually possesses; it does not occur to him to follow up the inquiry by the necessary methods; although he may be perfectly familiar with them, he may not think of them at the time, or at least he may fail to recognize their importance for the case on hand.

This Manual, however, does not aim at supplying an easy and certain method of making a diagnosis. It would be strange, indeed, if any book could teach a student to do that which the most accomplished physician is often unable to complete to his own satisfaction. But one well-trained in clinical observation, if unable to make a diagnosis, can at least examine his patient thoroughly, and it is in this respect that he has an immense advantage: the case is thus put in a fair way for a diagnosis whenever this becomes possible.

It seemed quite within the scope of a book to give some assistance in this clinical study of the signs and symptoms of disease, by supplying carefully selected data in a condensed form, by submitting accurate methods of investigation, by pointing out probable fallacies, and by directing attention to collateral inquiries or issues which might otherwise be readily overlooked by the inexperienced.

If some such assistance could be given, within one volume of convenient size, it seemed also that our teaching at the bedside might be relieved of an enormous mass of detail, which is apt at present to interfere with the higher forms of clinical instruction and research: the importance of these elementary details is so great that they cannot be omitted, or neglected in any way, in the teaching of large numbers, without disastrous results.

In attempting to produce such a volume as is here indicated, it was found expedient to apply to several contributors. Dr. Samson Gemmell has written the portion dealing with Physical Diagnosis: from his official position he was able to make free use of Professor Gairdner's lectures and teaching on this subject: he has, likewise, prepared a short section on the Sphygmograph, to which instrument he has devoted some special attention. In making arrangements for that part of the work which involved the detailed discussion of the symptoms of disease in the various Systems, it soon became evident to the Editor that it would be very desirable to obtain the assistance of experts in special departments, if the best results were to be aimed at. Professor Stephenson, accordingly, agreed to deal with the important department of Female Disorders; and Dr. Joseph Coats undertook the section on Laryngoscopy and Diseases of the Throat. With the development of the work it seemed desirable to add a chapter on Insanity, on account of the growing importance now attached to this branch of medicine, and also on account of the need which students feel of some guide in approaching cases of mental derangement; this portion of the book has been furnished by Dr. Alexander Robertson. But in the special sections of this work, thus committed to different hands, the writers kindly agreed to keep steadily in view the relation of the departments undertaken by them to the general scheme of the book; and so to keep the description of mere details in subordination to those aspects of disease important in an ordinary physician's practice: indeed the space available for these subjects forbade any attempt to deal with them in full detail. Certain parts of the clinical investigation were likely to be neglected in the plan of such a book, if a more general view of the aspect and physiognomy of the patient were not also supplied: to meet this want an introductory chapter on the Physiognomy of Disease has been furnished by Professor Gairdner, who has throughout given much assistance in the rest of the work. A concluding chapter on the Method of performing Post-mortem Examinations has been added by Dr. Joseph Coats: imperfect methods of examining the body after death often lead to the practical loss of most important and laborious clinical investigations.

No attempt has been made to follow out any very strict nosological plan or classification of subjects. The guiding considerations have always been convenience and utility. The limitations of space forbade any attempt to deal with the treatment of disease, although occasional allusions are to be found to the effect of remedies. When the nature of a case has been thoroughly mastered, so as to afford a trustworthy guidance to its position in respect of a true diagnosis, the whole literature of medicine is laid open for our assistance in the treatment.

Many portions of this book are adapted more for reference than for reading in a continuous manner; but others, it will be easily seen, can be read best in sequence. Some subjects are dealt with more fully than others: this has been determined, in large measure, by considering what were the parts of the clinical inquiry in which the student required most assistance, or in which his present books seemed defective for clinical purposes.

Some references have been given at the openings of most of the chapters for the benefit of beginners, who might not know the names of special treatises dealing with the various subjects in detail. To prevent repetition of the titles, a list of these is given separately after the table of Contents. It has not been thought desirable, as a rule, to cite authorities for the statements in the text. Numerous references to foreign books and to periodical literature would have been required in doing so, and it was feared that these would only confuse many readers. Occasionally a name has been introduced, in special circumstances, for the sake of clearness, and to avoid any mistakes which might arise from such an omission. In the absence of such citations, care has been taken, in the sections dealing with subjects on the borderland of medicine, to have them revised by those familiar with these departments. Various friends have kindly done this, and their names are omitted here simply to avoid attaching a responsibility to them which mere revision in this way scarcely imposes.

In the illustrations the aim has been to supply those which the student is likely to feel the want of in his actual bedside investigations. To keep the volume from being too expensive, no attempt has been made to illustrate those subjects which require color for their proper representation: it was thought better to omit such altogether. Instruments have likewise been omitted: the reader is supposed to be engaged in using those referred to. The illustrations are partly new and partly borrowed from recognized authorities. In particular, acknowledgment must be made of those obtained by the Publishers from the valuable work of Dr. Gee, and from the well-known book of my friend Dr. Wm. Roberts. Several have also been copied from Dr. Gairdner's *Clinical Medicine*. A list, with details of the sources of the illustrations, is given elsewhere. Dr. John Wilson (whose illustrations of the cutaneous parasites are already well known to the profession) has supplied several new microscopic drawings of great value.

J. F.

351 Bath Crescent, Glasgow,
August, 1878.

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CLINICAL DIAGNOSIS.

CHAPTER I.

THE PHYSIOGNOMY OF DISEASE.

IN examining for medical purposes a patient affected with some bodily disease, it is of importance for the inquirer to have before his mind from the first the nature and the scope of the inquiry proposed, and not to be misled by any of the merely conventional phrases or forms of thought under which plausible fallacies and rash generalizations are so prone to hide themselves. This remark applies with peculiar force to the investigation of the more external or physiognomic characters of disease, because it is in dealing with these that the physician is under the strongest temptations to appear wise at all hazards, and thus to formulate his knowledge (or his ignorance) under terms which may or may not be correct as regards the individual case before him, but of which he would find the exact definition extremely difficult, or impossible. Thus, it is very easy in a particular case to pronounce the patient "of a phthisical aspect," or "of a gouty habit," or "strumous," or of a rheumatic or other "diathesis," or to say that he has a well-marked "malignant," or "cancerous cachexy;" and any one of these expressions may, in the particular case, indicate something that is really true, while, nevertheless, the expression itself is altogether objectionable, and devoid both of real accuracy and scientific value. What the clinical observer has to do is not to grasp at a hasty generalization, but to note details of positive fact, and out of these to evolve the elements of a sure diagnosis. The statement that the patient has some peculiar and specific constitutional morbid tendency or bias is not, in any case, the statement of a fact, but of an opinion, and sometimes of a very insecure and fanciful opinion. Such a statement, therefore, should never be found among the preliminaries, probably, indeed, rarely even in the more advanced stages, of an hospital report; inasmuch as even when true in fact, it is an inference based upon many, and much simpler, facts which ought to have been separately noted. The same principle holds, perhaps still more strongly, as regards the so-called "temperaments"—sanguine, bilious, nervous, etc., and all their more complex varieties. Without discussing here at all the amount of truth, or of reality, underlying these expressions, it may be certainly affirmed that their relation to particular diseases is almost wholly illusory; and, therefore, the statements in which the *elements* of a diagnosis, so to speak, are concerned, should be as simple and precise as possible, and should certainly not involve any general doctrine or theory of the disease or of its causes.

Nevertheless, it is quite true that diseases, considered as disturbances of the physiological course of a healthy life, are often marked by incidents which leave indelible traces not only in the history, but on the physical structure of the body; and it is the study of these, properly speaking, which affords to the well-informed physician almost the whole basis of objective fact out of which a morbid tendency, or diathesis, can be inferred with a fair amount of probability. In other words, *diathesis*, as a study of facts in an individual case, is an inference either from previous facts in the history indicating deranged physiological function, or from manifest structural changes, the result of these; whereby we are enabled to establish, but only as a presumption founded with more or less probability on the evidence, the existence of a *tendency* to similar changes, or changes of some allied order, in the future. In other words, the proof of *diathesis* is essentially the proof of *disease;* but, it may well be, disease in its earliest manifestations and least notable forms.

There is a whole group of diseases, for example, which affect the human body chiefly or exclusively during its period of growth, whether of early infancy or of adolescence; and another group, the first approaches of which are usually observed only along with, or succeeding, the physiological signs of senile decay. As regards the latter group, it may be said with truth that physiology and pathology are inextricably intermingled. A too early *arcus senilis*, or the premature development of "crow's feet" at the outer margins of the eyelids, wrinkles in the skin of the face, diminished sensibility of the retina, or early presbyopia; still more, the well-known changes in the arteries, twisting or rigidity of the radials, etc.; falling or grayness of the hair, diminution or loss of sexual activity, and cessation of the catamenia in women; all of these (and yet perhaps none of them singly and unsupported by the others) may be appealed to as evidence of a liability to diseases of the senile group generally; and, if further corroborated by slight manifestations of actual disease, or of organic changes the result of disease, may form considerable elements in the diagnosis of a diathesis, as for example, a tendency to hemorrhagic apoplexy. Or again, certain transverse markings upon the teeth (quite distinct in character from those to be afterwards noticed as syphilitic); curvatures, or other alterations in the form of the long bones, and a certain well-known conformation of the thorax, may indicate with the utmost precision disorders proper to the period of the first or of the second dentition, when rickety distortion, with or without bronchitis and other severe but not permanent conditions of disease interfering with the free expansion of the lungs, may have left an impress upon the bony skeleton. So, too, it may be remarked that the presence or absence of traces of past disease of the bones and joints, or of glandular enlargements and cicatrices in the neck, or of spinal disease, may, together with a certain conformation of chest, or indeed of the body generally, form part of a chain of circumstantial evidence, as it were, tending to prove, or to disprove, a liability to tubercular disease of the lungs. But what has chiefly to be rooted out of the mind of the ill-informed, or imperfectly trained, clinical student is the impression that such conclusions are to be safely reached through mere phrases appealing largely to the imagination without minute and careful study of details. The popular, and to a certain extent the half-educated medical mind, is always looking for a pathognomonic sign, or a broad, striking, easy generalization from a few facts; whereas it is only by ripened experience that we come to know gradually the real value of common and obvious, still more, of uncommon and not obvious, facts *when seen in combination*, so as to form conjointly a basis for large inferences. Such a diagnosis, however, is often the result of the careful study of the *physiognomic* characteristics of individual patients.

In beginning the study of this subject, it is impossible to overlook the importance of the *weight* and *size* of the body as a test of its physiological condition. Many diseases, perhaps indeed all diseases attended by fever, and many or most of the organic diseases of the viscera, whether febrile or not, are characteristically marked by a loss of weight, which often bears some sort of relation to the progress of the disease, especially in cases that end fatally. This tendency is the physical expression of a derangement of the entire textural nutrition of the body, which, as a rule, becomes apparent externally, in the first instance, through the gradual wasting of the stores of fatty material in the subcutaneous layers and in the interstices of the muscles, omenta, orbits, etc.; but which really carries as an ultimate result the wasting of every texture in the body—the bones, the fibrous tissues, and the nervous centres being (according to Chossat) the last to become appreciably altered in weight; the brain, indeed, almost inappreciably, even in an animal starved to death. But in morbid inanition (as opposed to this physiological kind) there is usually not only deficient, but altered, tissue-formation; so much so, that while fat disappears from all the usual situations in which it is normally stored up, fatty or oleo-albuminous molecules are formed in the microscopic elements of the wasting textures generally, and chemical products, also, of decomposition of the nitrogenous tissues are found in excess in the blood, muscles, and glandular viscera. And this may take place (as in diabetes mellitus), when large quantities of actual nutritious matter of various kinds are passed through the organs of assimilation, and are even digested and assimilated, up to a certain point, with preternatural activity. In such cases it has been said, with a certain amount of truth, that the body becomes *autophagous*, or self-devouring; the muscles feed upon the integumentary tissues, the brain and nerves upon the muscles; the new nourishment conveyed into the system, if any, being wasted and rapidly excreted, along with the effete matter of the wasting tissues. This state of morbid emaciation is most easily recognized in the living patient by gradual loss of weight, as well as by the external characters of shrinking and shrivelling of the soft tissues, in the order indicated above as a general rule. But loss of weight, as a personal and individual fact, can be exactly established only by repeated weighing of the same patient at intervals; and in hospital wards this ought to be done on admission, and afterwards every week or two, so as to obtain an accurate view of the progress of the case. In private practice, among men of the well-to-do classes, it is quite common, nowadays, to find that the habitual or physiological weight of the individual, and even the amount of variation in it in the midst of apparent good health, are well enough known to patients themselves, from actual weighings more or less frequently repeated; and by availing ourselves of these spontaneously provided data we are often able to form a tolerably clear conception of the morbid changes present at the time of first seeing the patient. But in other cases no such data exist; and the "personal equation," so to speak, of weight has to be adjusted for the individual from more general statements, or from actual observations founded on averages. But this is by no means easy; for the limits of variation in weight consistent with health, even in the same individual, have yet to be determined; and the extreme limits of difference in a number of individuals of like stature are notoriously so wide, even under strictly physiological conditions, as to render all averages inapplicable to the extremes. A vast series of observations by Dr. Hutchinson is, from this cause, of comparatively small value to the clinical observer as furnishing a standard of health, it being necessary to allow for great variations in both directions from the mean weight corresponding to stature; but perhaps the following condensed summary may be adopted as an approximation to the actual truth:—

A man of 5 feet should weigh from 8 to 9 stone.
" 5 ft. 3 in. " 9 " 10 "
" 5 ft. 6 in. " 10 " 11 "
" 5 ft. 9 in. " 11 " 12½ "
" 6 ft. " 12 " 14 "

These numbers (as already stated) are not to be taken as being more than approximations to a normal standard of relation, subject to considerable latitude of interpretation in both directions. In applying them to an individual case it will be well to ascertain, as far as possible, the life-history of the patient in respect of height and weight proportion, if not in exact figures, at least in such terms as may be conventionally well enough understood for practical purposes. Supposing, for example, that the patient is a well-grown man, verging towards the "sere and yellow leaf," and in advancing age evidently tending to accumulate fat in the abdominal wall and elsewhere—Was he always "stout" (in the sense of his present condition), or was he, as a youth, "thin," or "slender," or "wiry," or "a light weight"? All of these are expressions well understood by most men as conveying easily-appreciable relations of bodily conformation, and the last of them might even lead to more exact statements tending to determine the precise time of life when the *sense* of an increasing burden of flesh became manifest as a subjective fact. In the growing period of the body it is quite common to say of persons of slender habit, that they "shot up very fast," *i. e.*, that the increase in height did not carry corresponding breadth along with it in boyhood; and this expression, or something like it, is often used by mothers as indicating a fear or misgiving that the phthisical tendency, either as a diathesis, or even as an actual disease, may have existed or been manifested at an early period of life. "Wiry," again, is generally open to a different interpretation; it corresponds, in a man, to what in a woman would be called (but not, of course, by herself or her friends) "scraggy," or "raw-boned;" viz., a physical conformation in which bone and muscle predominate, and the whole organization indicates a robust and active rather than a graceful or refined personal presence; but, nevertheless, a bodily organization perfectly sound in essentials, and eminently fit, from its very hardness and angularity, to do rough work in the battle of life. "Thin," or "slender," in a man, perhaps conveys the trace of an imputation of physical inferiority, or, on the other hand, these expressions may be perfectly indifferent as regards previous health or disease. The physical opposites of these bodily states, within the limits of health, are usually conveyed by the expressions "lusty," or "stout," or "in good condition," and a little good-humored allusion, half in a joke, will often elicit most important facts for the physician; indeed, beginners would do well to study the facetious vocabulary of Prince Hal, as applied to that great impersonation of vigorous and humorous rotundity—Falstaff, in the pages of Shakspeare.[1] In women, and especially in those who have still reason to be careful about appearances, it is necessary to take care not to give offence by a too abrupt or coarsely-worded question; but with a little tact there is no real difficulty in getting at the facts in a round-about way, and even without using the sickly French slang of "embonpoint," which is supposed by some to be specially polite language as applied to ladies of a somewhat too large and substantial *physique*. But in all these inquiries and observations it is to be remarked that the experience of years, and the critical appreciation of the human form under a great variety of conditions, normal and abnormal, gives to the physician in many cases a power akin to that of the artist, incommunicable by words; an instinct of divination, so to speak, by which the true character and the history of the organism may be read in the external features and physical characteristics; and this, not only as to health and disease, but as to all the leading elements of character.

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[1] "King Henry IV.," Part I. — The converse of the character of that lusty knight, who might be supposed to be the original of the proverb, "Laugh and grow fat," will be found in Cæsar's remark on Cassius as a probable conspirator, and "dangerous," on account of his "lean and hungry look," his much thought and reading; his keen penetration "quite through the deeds of men;" and his contempt of personal gratification and amusement. A perfect type of what would be styled in old medical language the "bilious," or rather "atrabilious," or "melancholic temperament."—See "Julius Cæsar," Act I., Scene 2.

There is one remark that will not, perhaps, quite readily occur to the superficial observer, but which is, nevertheless, of the widest possible application to the subject of body-weight, and of the greatest significance in respect to the physiognomy of disease. It is natural, perhaps inevitable to think of great and small body-weight as being really o posed or contrasted conditions, just as we think of giants dwarfs as opposed or contrasted in respect of statur general bulk. But this is a false, or at least a misle analogy; for while a son of Anak may be in every way as healthy and as well proportioned as a General Tom Thumb, it is impossible to look upon excessive any more than defective body-weight, *per se*, as a mere question of *big* or *little*. Up to a certain point, indeed, and within the limits of strict physiological health, the increase of bulk may be a mere question of degree; *e. g.*, a man of medium stature may be 140 lbs. in weight, or he may be 180, or even, perhaps, 200 lbs.; if the *proportion* of all the more important or essential bodily parts is fairly preserved, *e. g.*, of the muscles and ligaments to the bones, of the viscera of the chest and abdomen to the external structure, and of the cavities to the viscera, there will not be necessarily, at least, any appreciable impairment of function, or any disease. But the tendency of extremes in both directions is very apt to be towards impaired function, and therefore towards actual or proximate structural disease. And in the case of excessive corpulence, still more than that of excessive emaciation, it may be said that the morbid tendency, once implanted, is apt to be *progressive;* the functions and structures that are oppressed by the abnormal growth of fatty tissue being thereby permanently, though very gradually, altered, so that most of the tissues visibly degenerate, and what seems at first sight to be an *hypertrophy* of the bodily frame becomes, in a most genuine and physiological sense, a true *atrophy* of some of the most important and vital parts of it. Thus, fatty atrophy of the heart, of the secreting cells of the liver and kidney, and of other important organs and parts, is extremely common in cases of excessive corpulence; and the blood itself, there is strong reason to think, undergoes in such cases a kind of relative atrophy, both its amount and its nutritious quality being more or less impaired. Hence the old and probably correct observation derived from the days of large blood-lettings, that *stout* subjects (in the sense of *corpulent*) do not bear loss of blood nearly so well as those of more slender bodily constitution. It is also notorious that such subjects often succumb much more readily to fevers and other exhausting diseases than those of " wiry" frame, or even those who, from defectively slender development, may have appeared to be of a much inferior *physique*. It is not at all clear, therefore, that any amount of external fat beyond a fair average is, physiologically speaking, advantageous to the possessor. And it is just at the period of life when the first traces of senile decay begin, that the embarrassment caused by an excess of rotundity is most apt to tell upon the constitution. Generally speaking, a moderate accumulation of fat up to the age of 40, or even 45, is wholesome rather than otherwise; and if associated with a broad chest, well-developed and active muscles, an energetic character, and a healthy respiration and circulation, will tend to long life, even if the digestion should be, as often happens, rather feeble. But increase of fat to a notable degree beyond the middle term of life is always to be regarded with suspicion, as implying a probability of vital and dynamic conditions of nutrition tending to precipitate the process of the senile decay. And anything like marked obesity persisting to, or increasing at, the age of 60 is a manifest invasion of the prerogatives of that age which has been characterized as that of the " lean and slippered pantaloon." On the whole, it may reasonably be doubted whether the "spare" constitution of body, if it be free from, or escape, the risks incidental to actual disease in childhood and adolescence, is not in reality more favorable to long life than any considerable amount of fat. There are no statistics on the subject; but the medical observation of mankind in general shows that, as in Pharaoh's dream, it often happens that "the ill-favored and lean-fleshed kine did eat up the well-favored and fat kine." And the spontaneous and instinctive expression of the late Mr. Banting as to his excessive fatty envelope, viewing it, as he did, as a "parasite" destructive both to health and comfort, is not so far removed from truth as are many popular estimates of this condition of body.

The ideal of a sound and perfectly organized bodily structure at the various ages of life has been so beautifully presented to us in the masterpieces of ancient and modern sculpture, that every medical student or physician who desires to keep his eye and mind in training would do well to spend an hour now and then in a gallery of casts or marbles, and to compare the perfect forms coming from the chisel of Phidias or Praxiteles, Thorwaldsen or Canova, with those habitually seen in the hospital or consulting-room. He will then come to appreciate by his senses what is simply a physiological and, indeed, a physical fact, that there is an ideal relation of size and form as between every separate part of the human body; and that every outward and inward structure contributes an exactly-balanced proportion to the whole visible result. The study of this proportion, as affected by disease, and as modified by action and suffering, constitutes the physiognomy of disease.

In *spare* habits, or when there is a reasonable suspicion, *à priori*, of phthisical atrophy, the following points require to be observed, especially in early adult life. The presence of "clubbing" of the finger ends, or of undue curvature of the nails; the red line on the gums, said to be more or less characteristic of tubercular disease; the peculiar momentary starting and elevation of the skin produced by a tap of the finger point over the costal cartilages, and described as "myoidema;" any undue, and especially any unilateral, flattening below the clavicles, or deformity elsewhere of the chest, and any inequality, or want of symmetry, in the respiratory movements; any rapid and too easy flushing of the face, and especially that limited flush of the cheek with pallid complexion generally, which denotes fever in an exhausted constitution; any or all of these may in particular cases be valuable indications of truly morbid emaciation.[1] In infants and children, sometimes also in adults, it is not uncommon to observe emaciated limbs and face, with an enlarged abdomen (almost always a sign of grave, often tubercular, disease). And in very young infants the presence of emaciation generally, with a retracted abdomen, and a large head, the anterior fontanelle (if still open) being protruded instead of depressed, is a combination of signs of the gravest import, as tending to reveal disease of the meninges of the brain, even should the symptoms otherwise be obscure or wanting; still more, if these indications are accompanied by peculiarities of expression, or abnormal movements of the eyes (strabismus, nystagmus) or of the pupils; or by the phenomenon described by Trousseau as the "tache cérébrale," and considered by him to denote fever with a cerebral or meningeal lesion.[1]

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[1] These subjects are referred to in detail under the sections on the Nails, General Signs of Pyrexia, Gums (Chapter xi.), and

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in those dealing with the physical examination of the Chest (Chapter xvi., Part 1). Myoidema is the name first applied by Dr. Lawson Tait ("Dublin Journal of Medical Science," vol. 52, p. 316) to a phenomenon observed long ago by Drs. Graves and Stokes ("Dublin Hospital Reports," vol. 5, p. 70), as probably characteristic in some degree of phthisical emaciation, and as being found most frequently "in incipient phthisis over the seat of the irritation"—*i. e.*, on the side first affected and in the supra-clavicular region. According to Dr. Tait, the sign attends especially the *softening* stage of tubercle. "After each stroke of the ends of the fingers" (say the first discoveries of this sign) "a number of little tumors appeared, answering exactly to the number and situation of the points of the fingers, when they had struck the integuments of the chest. These having continued visible for a few moments, subsided, but could be again made to appear on repeating the percussion." [My observations, in very numerous instances, lead me to concur with the original description here given more closely than with the details of fact and of procedure in Dr. Lawson Tait's paper. In particular, I have found that the "little tumors" of Drs. Graves and Stokes, which are undoubtedly the more important part of myoidema, are produced more easily, and with far less risk of fallacy, when the percussion is made, not over a voluntary muscle at all, but over the anterior costal cartilages. The name therefore seems, in a certain sense, a misnomer, if it is intended thereby to suggest that the contraction of the fibrillæ of voluntary muscle has anything to do with the more distinctive phenomena. The "little tumors" are quite evidently due to a temporary contraction of muscular fibres in the skin itself, similar in kind to those of the dartos on pinching the scrotum. I believe the phenomenon, thus interpreted, to have some, but by no means a pathognomonic, significance.—W. T. G.]

[1] On drawing the back of the nail or the blunt end of a pencil along the skin, we find, in the healthy subject, that a momentary whiteness of the part is followed after a time by a distinct red streak. But in certain states this redness is much more easily pro-

A condition frequently, but not necessarily, associated with the phthisical or morbidly emaciated habit, is *Anæmia;* a term which has been variously defined, but which may be taken as corresponding in general not so much with diminution in the absolute quantity of the blood as with depreciation of its quality; a lower specific gravity of the serum, a more or less considerable fall in the proportion of the blood-corpuscles, and of course of the coloring matter. Physiognomically considered, anæmia is recognized chiefly or exclusively by this last character; and the most marked examples of it are those in which emaciation, though perhaps present more or less, is not extreme. If, indeed, the blood is simply reduced in quantity as a part of the general emaciation, but remains not greatly out of proportion to the other tissues (as in many cases of phthisical emaciation), the characters of anæmia will not be at all strikingly present. The lips will remain well colored, and the mucous membranes may even be morbidly congested in such a condition. But when, along with only a moderate reduction in the amount of the solid soft tissues, and without any circumstance tending to the local determination of blood, there is a great reduction in the *quality* of the latter, the consequences as regards the appearance of the patient are very striking. There is, in the first place, an extremely pallid hue of the whole surface, and especially of the face; lips not quite so pale as the rest of the countenance, but entirely devoid of their natural rosy hue; the conjunctivæ of the eyelids similarly pale; the ocular conjunctivæ bluish, from the shining through of the choroid: and all these characteristics brought out the more remarkably in dark complexions, inasmuch as the tints which depend not on blood but on pigment may be unchanged. Thus the skin may be nearly as pale as that of a corpse, and yet there may be dark circles (chloasma) round the eyes or on the brow; or the natural diffused pigment of the whole surface may be so exaggerated as to give to certain parts of it almost the appearance of the skin of a negro or mulatto (the so-called "bronzed skin" or "Addison's disease"). But in cases of anæmia, pure and simple, there is usually no special pigmentary change, and the whole external characteristics

duced, and is likewise very much more intense and persistent; it is to this excessive redness that the term *tache cérébrale* is applied, from its being frequently observed in cases of acute meningitis. But it is now quite certain that it may be found equally in many cases of enteric fever, and in certain other diseased conditions.

suggest merely an unduly watery or much impoverished blood. The skin is cool, and the tongue may be clean, though extremely pale; there is often a little puffiness of the eyelids and dropsical swelling of the ankles; it may be (as in Bright's disease) even general dropsy of the entire subcutaneous tissues. The muscles are flabby rather than much reduced in bulk; the expression is that of great languor, but not of suffering or of anxiety; if the texture of the skin is fine and delicate, the blue veins may be seen below the surface, but reduced very much in volume as compared with the normal; and in the veins of the neck there is found the well-known humming of the "anæmic murmur" or "bruit de diable." A special variety of this state of pure anæmia is chlorosis, in which greatly disordered or absolutely arrested menstruation in young girls is attended by all the circumstances above noted, often with a very remarkably green tint of the complexion (as the name implies). In all these cases the blood, tested accurately by Malassez's instrument or by the hæmochromomètre, shows a reduction in the amount of coloring matter, or of corpuscles, equal to one-third, one-half, or even more; and in this way a physiognomic sign, which formerly could only be stated in general terms, can now be reduced to most accurate expression, and made subservient to exact observation as to the progress of disease or the results of treatment. (See Chapter ix.)

When this anæmic condition is recognized, we must never rest satisfied in the investigation of the case till we have done our best to ascertain the probable cause. We inquire for the history of any hemorrhages or any of the less obvious forms of loss of blood described elsewhere (Chap. ix.) A similar deterioration may result from the chronic influence of the malarial fevers, for example, or from the recent occurrence of some acute illness from which the patient's system has not fully recovered. But too often such anæmia is only symptomatic of the serious inroads of tubercular, syphilitic, malignant, or renal disease, and the investigation of the urine is so important in all apparently causeless forms of anæmia that it must never be neglected. Present or past suppuration of a chronic character may likewise be responsible for the deterioration of the blood; the extreme pallor and the wax-like appearance of patients suffering from the lardaceous, waxy, or amyloid degeneration of the viscera usually arise from such prolonged suppurations, but this disorder may also be due to less obvious causes. The examination of the blood frequently guides to the diagnosis of Leukæmia and to the investigation of the spleen; or the general enlargement of the lymphatic glands may suggest the presence of Hodgkin's disease as the cause of the persistent anæmia. But after eliminating all these causes of the deterioration, we may still find ourselves in the presence of a simple *progressive pernicious anæmia*, the origin and pathology of which still remain obscure, while the tendency to death is very marked.

The converse of anæmia, in medical language still current, is *Plethora;* a condition which has had a great deal to answer for in medical pathology and treatment. But plethora, considered merely as a morbid *excess* of blood, can hardly be said to hold its place among recognized pathological states at the present day; fulness of blood, in other words, can scarcely be considered morbid unless there is some other pathological change either as regards its quality or its distribution. The condition to which the name plethoric is usually applied is one in which there is stagnation of blood in the smaller veins of the surface, giving to it, especially in the face and nose, the rubicund and "port-winey" appearance suggestive of the days when two bottles of that luscious stimulant were regarded as a moderate allowance for a gentleman at an after-dinner sitting. This peculiarity of countenance, as well as the plethoric and well-fed condition generally, when occurring in persons (especially males) past the middle term of life, particularly if associated with hereditary predisposition or with known habits of self-indulgence, has been regarded as among the notes of the gouty habit or diathesis, and also, along with a short and thick neck, as among the predispositions to apoplexy.

There is a very remarkable condition of the blood and of the containing vessels, in one of its aspects allied to anæmia, in another to plethora—that, namely, which, attended with coldness of the surface and rapid depression of the powers of life, corresponds with the so-called "collapse" or "algide" stage of Asiatic cholera. In so far as this condition can be here dealt with, it may be regarded as one in which a highly-concentrated blood encounters resistance in being driven through the capillaries; the great mass of the blood, therefore, tending to accumulate in the venous system, and producing congestion, and even ecchymosis, by rupture of the smaller veins. It has been shown by chemical analysis that the blood in this condition has lost a considerable proportion of its water and albumen, owing to the enormously rapid and copious discharges from the intestinal canal; but the blood corpuscles remain, for the most part, in the vessels. There is, therefore, a strange combination of shrivelling of most of the textures of the body from loss of fluid, and persistence of blood-color, altered, however, in the direction of lividity by deficient aëration. A person in this state has the skin, especially in the face and extremities, of quite cadaverous coldness, and often has the whole attitude and expression of a corpse; the ends of the fingers are shrivelled, the features thin and pinched, the nose and all the extremities livid in a high degree; the conjunctivæ are bloodshot and ecchymosed; the eyes sunk in the orbits; the tongue and breath cold; the respiration and circulation almost inappreciable; but there is no disappearance of the external fat, nor any true emaciation; the breasts, accordingly, in women, and the abdomen in corpulent men, remain well clothed with integument even after death. A condition more or less allied to this is seen in some cases of acute peritonitis, tending rapidly to death, as in perforation of the bowels, which, like cholera, may cause death by collapse in a few hours, though, of course, without the excessive evacuations above referred to.

The traditional description of the so-called *Facies Hippocratica* is not very far removed in some of its details from the state of acute collapse as above described, and has been so often formulated in one shape or other by compilers, as conveying the elements of a fatal prognosis, that it may be as well to transcribe the words from the original source: "a sharp nose, hollow eyes, collapsed temples; the ears cold, contracted, and their lobes turned out; the skin about the forehead rough, distended, and parched; the color of the whole face green, black, livid, or lead-colored." But the reader will do well to consult the other physiognomic details in Sec. 2–4 of the Prognostics of Hippocrates (Dr. Adams's translation, vol. i. p. 236) for numerous vivid and picturesque touches which are now among the common-places of medical observation. And the description of the phthisical body by Aretæus is equally deserving of attention, as a sample of accurate appreciation of detailed facts emanating from remote antiquity. The most important facts of the description referred to are as follows, but the whole chapter in the excellent translation of Dr. Adams well merits perusal:—

> "Voice hoarse; neck slighly bent, tender, not flexible, somewhat extended; fingers slender, but joints thick; of the bones alone the figure remains, for the fleshy parts are wasted; the nails of the fingers crooked, their pulps are shrivelled and flat, for, owing to the loss of flesh they neither retain their tension nor rotundity; and owing to the same cause, the nails are bent, namely, because it is the compact flesh at their points which is intended as a support to them; and the tension thereof is like that of the solids. Nose sharp, slender; cheeks prominent and red; eyes hollow, brilliant, and glittering; swollen, pale, or livid in the countenance; the slender parts of the jaws rest on the teeth, as if smiling; otherwise of a cadaverous aspect. So also in all other respects; slender, without flesh; the muscles of the arms imperceptible; not a vestige of the mammæ, the nipples only to be seen; one may not only count the ribs themselves, but also easily trace them to their terminations; for even the articulations at the vertebræ are quite visible; and their connections with the sternum are also manifest; the intercostal spaces are hollow and rhomboidal, agreeably to the configuration of the bone; hypochondriac region lank and retracted; the abdomen and flanks contiguous to the spine. Joints clearly developed, prominent, devoid of flesh, so also with the tibia, ischium, and humerus; the spine of the vertebræ, formerly hollow, now protrudes, the muscles on either side being wasted; the whole shoulder-blades apparent like the wings of birds. If in these cases disorder of the bowels supervene, they are in a hopeless state. But, if a favorable change take place, symptoms the opposite of those fatal ones occur."—*Aretæus*, *Causes and Symptoms of Chronic Diseases*, Book I., Chapter viii.; *On Phthisis.*

In association with the various atrophic and anæmic states above referred to, we have to consider the physiognomic import of another much abused word, around which, as around the words "diathesis" and "temperament," a great deal of very obscure pathology has been made to revolve. *Cachexia*, in its original and etymological sense (κακός and ἕξις), means any bad or defective habit of body—*habitus depravatus*—usually the result, not the cause, of disease. The term "habit" here implies, of course, chronicity; and the word cachexia is, accordingly, one consecrated by usage to the definition of states characterized by chronic lesions of nutrition, as opposed to the fevers and acute diseases. In the systematic nosologies—Cullen's for example—the *Cachexiæ* form an order including all chronic diseases of nutrition which are not strictly local, and not obviously associated with fever. Hence cancers, dropsies, rickety affections of the bones in childhood, and above all, the various types of glandular, articular, pulmonary, cutaneous diseases, known either as scrofulous or tubercular, are commonly enumerated among the cachexies; and more modern authors add gout, rheumatism, scurvy, and syphilis to the list. But the use of the thermometer tends very much to break down the distinction between the febrile and the non-febrile diseases—between the *pyrexiæ* and *cachexiæ;* and in some of the latter, *e. g.*, in tubercular diseases and in syphilis, the febrile element, though spread over longer periods of time, and therefore less intense as a rule, is quite as really, if not invariably, associated with many of the nutritive changes as in the pyrexiæ commonly so called. It cannot, therefore, be admitted that there is anything in the essential nature of a cachexia to differentiate it pathologically from a fever, or from an acute disease like pneumonia. There is, it is true, the element of *time*, implied in the long duration and very gradual evolution of the disease; but the relation of the local changes to the constitutional disease is, in the cachexia as in the fever, a matter of inference from the study of the whole of the phenomena; and it is impossible to admit, *à priori*, that a specific, and latent, constitutional taint always precedes and determines the local affection. The safe rule of physiognomic diagnosis here is, to make the discovery of a cachexia (as of a diathesis) an inference from individual facts actually observed and verified in the particular case; not a general formula such as is often implied under the terms scrofulous, strumous, syphilitic, gouty, or cancerous cachexia. It may be easily admitted, indeed, that these cachectic states actually exist in connection with the diseases named; but what is not so easily admitted is the proof of the cachexia apart from all positive manifestations of actual disease of the special kind implied in its name.

The following brief indications, however, may be noted as regards particular types of cachexia. In the *Scrofulous* or *strumous* variety, as also in a certain proportion of cases of tuberculosis in the adult, there may be found evidences of defective nutrition, or emaciation, extending back to childhood, and modifying the entire form of the skeleton, as well as the integument. A slender form, and a narrow or deformed chest may be accompanied by the cicatrices of glandular abscesses, or of sinuses connected with the bones; a delicate, pale skin, or one marked by traces of eruptions on the scalp or elsewhere; often with retarded puberty, and imperfectly developed organs of sex; flabby muscles, attenuated bones, and relatively large (sometimes anchylosed or actively diseased) joints. The upper part of the abdomen may be increased in bulk, from waxy enlargement of the liver; or the whole abdomen, from disease of the peritoneum or mesenteric glands. The patient is commonly more or less anæmic, and is often (sometimes periodically) subject to febricula (hectic).

In the *Gouty* habit there is frequently no cachexia, properly speaking, at all appreciable until the middle term of life is reached or past. There may, on the contrary, be all the indications of strong vitality, robust conformation, and great bodily and mental activity. At a certain period of life, however (prematurely or not), the ordinary signs of *ageing* occur; and along with these (and with the cessation of the catamenia in women) comes an increase of obesity, or the plethoric development of the facial veins (described above); eruptions on the skin; varicose veins in the lower extremities; manifestly diminished energy, and sometimes oppression of breathing. Preceding or succeeding these signs may occur the special deformities due to the local deposits of uric acid in the joints of the toes and fingers, or (as Dr. Garrod has remarked) in the lobes of the ears. The peripheral arteries often present at this stage well-marked senile degeneration. There are, however, not a few exceptions to these remarks; and the gouty habit may even concur with, or follow, the scrofulous cachexia, as age advances.

It is doubtful whether any very definite cachexia can be said to accompany *Cancerous* disease, apart from the local developments of it in the organs, and their consequences. But in the majority of cases of gastric, hepatic, omental, or uterine cancer, and in not a few mammary and other external cancerous growths, there are either extreme emaciation and anæmia, or persistence of the external fat with flabby integuments, and a peculiar sallow pale complexion; the expression of the countenance at the same time indicating habitual suffering and great despondency of mind.

Dropsical cachexia is most frequently associated with Bright's disease of the kidney. It is marked by great pallor, a languid expression without suffering, unless from difficulty of breathing; often puffiness of the face and eyelids; absence of fever, and an almost perfectly dry, cool skin, sometimes of fine, semi-transparent texture, at other times locally thickened and even wrinkled or furrowed from the effects of long-continued dropsical effusions, especially in the lower extremities, scrotum, and loins.

It does not appear at all clear (notwithstanding the well-known description by Dr. Todd of the "rheumatic diathesis"), that either in acute or chronic *Rheumatism* there is any definable cachexia or physiognomic peculiarity of bodily conformation, apart from the more obvious history and consequences of the disease.

In *Rickets*, there is a precursory or incubative stage of impaired general health of cachexia (according to Sir William Jenner, *Medical Times and Gazette*, 1860, vol. i.) extending usually from the fourth to the twelfth month of the infant's life. More or less emaciation takes place, and the movements indicate languor and peevishness or moroseness, perhaps with hot skin and a degree of low febrile irritation. By and by it is observed that the natural impulse of healthy children to play about, does not exist; the child prefers to lie still, and refuses to be amused; the superficial veins become large, and the jugular veins especially are much dilated; the hair continues thin upon the scalp, and the fontanelle remains widely open. Inter-current diseases of the chest may occur even at this stage, and may considerably modify the progress of the rickety cachexia; but three truly physiognomic characters are specially noted by Jenner, as appertaining to, and distinctive of, rickets, even in advance of the characteristic deformities of the skeleton, which are not often easily observed until the little patient begins to walk. The *first* is, profuse perspiration of the head and upper part of the body, especially during sleep, with large and full veins of the scalp and sometimes undue pulsation of the carotids. The *second* of these early symptoms is an intolerance of covering at night; the child insisting on kicking the bedclothes off, and lying with naked limbs, so as to be "always catching cold," according to the mother, who tries in vain to keep the infant properly protected. The *third* characteristic symptom is positive suffering when touched, or even when approached, by strangers, obviously from general tenderness, both of the surface and of the muscles and bones: an exaggeration of the state above described as existing at the very earliest stage of this cachexia. "A child in health," says Sir Wm. Jenner, "delights in movements of every kind. It joys to exercise every muscle. Strip a child of a few months old, and see how it throws its limbs in every direction; it will raise its head from the place where it lies, coil itself round, and grasping a foot with both hands thrust it into its mouth as far as possible, as though the great object of its existence at that moment was to turn itself inside out. The child, suffering severely from the general cachexia which precedes and accompanies the progressive stages of the bone-disease in rickets, ceases its gambols; it lies with outstretched limbs as quietly as possible, for voluntary movements produce pain." The consequence of all this suffering, after a short period, is further permanently imprinted on the physiognomy in an aspect not only of languor, but of premature sadness and sedateness, as of age, the effect of which is increased by the inability of the muscles to support the spinal column, which becomes curved forwards in the cervical region, and backwards in the dorsal. The bones of the cranium are soft and thin, yielding in some cases to pressure like card-board, and the form of the skull is altered, flattened behind or at the vertex, and protuberant in front. There is enlargement of the ends of the long bones; the ribs are "very soft, so that there is great recession of each rib where it joins the costal cartilage at each inspiration." It is easy to see in this description of the signs of a "cachexia" a very real and present disease, the source of all the deformities and permanent alterations in rickets, to which we have already alluded as being themselves, in after life, physiognomic evidence of disturbed health and function during the period of childhood.

The *Syphilitic* cachexia is so plainly a part of the actual disease, defined and demarcated by the well-known succession of the various stages and external and internal lesions, that it seems unnecessary here to treat of it in detail, as the evidence of its presence is dealt with under special sections in connection with the throat, the skin, the bones, the joints, etc. But in long standing cases of syphilis its deep influence on the system is often manifested, not merely by an appearance of bad health and general delicacy, but also by a dingy, sallow and somewhat discolored appearance of the skin of the face; this may impart to such patients something of the physiognomic aspect of malignant disease already referred to.

In all bodily conditions involving *Fever*, whether classed among the specific fevers or not, there are certain physiognomic characteristics which ought to be constantly present to the mind of the physician, not only as throwing light on the diagnosis, but often also on the prognosis and treatment. Thus, in the earliest periods there is the somewhat collapsed appearance, the pallor, the shivering, and *cutis anserina* which belong to the cold stage. At a later, but still early, period, the face is flushed, the expression is that either of languor or of pain, according as there is or is not a local disease; very often the attitude indicates restlessness, as when the patient is found overnight or in the early morning with the bedclothes tossed and disordered, and the body more or less exposed. In this stage the skin may be dry or moist, or it may be dry on the exposed parts and moist under the clothes, or *vice versâ*.[1] In certain fevers, as in the rheumatic and pyæmic kinds, moisture of surface and often profuse sweating predominate throughout; in others, as in scarlet fever and most of the eruptive fevers, a dry hot skin is more characteristic of the early stages up to the height of the fever. In phthisis and most of the fevers accompanying organic disease, sweats of considerably intensity alternate with hot and dry skin, often repeatedly in the course of twenty-four hours (hectic fever). In fevers accompanying diseases gravely affecting the respiration, as in pneumonia and broncho-pneumonia, the flush on the cheeks has a peculiar duskiness or lividity; this is very notably the case, also, in acute tuberculosis. In some cases of pyæmia the febrile characteristics are associated with a yellowish color of the integument, or even with jaundice. A like change may take place when the liver is directly involved in the disease, and even in some cases of pneumonia. Fevers depending on septic poisoning of the blood are recognized by the peculiar odor, as of putrefaction, which exhales from the body even at an early stage, before the cadaveric odor or the symptoms of approaching death have appeared; such cases may have a traumatic origin, or they may occur spontaneously, as in some instances of enteric fever, of erysipelas, of dysentery, and of septic poisoning from infection. Fevers depending on abscess, or upon profuse suppuration in connection with mucous or serous surfaces, are often very specially characterized by the tendency to intense and repeated shiverings, which can be compared only to the commencing stage of the ague-fit. A like disposition to rigors sometimes follows the passing of a catheter or bougie into the bladder, and this without any appreciable injury done to the mucous membrane. All these phenomena may be fairly included in the range of physiognomic diagnosis; the more precise appreciation of temperature through the thermometer will come under consideration hereafter (see Chapter iii.). In all fevers which continue for more than a brief period, the tongue becomes more or less coated with a white or yellow fur; in the hectic of phthisis, however, and in some cases of enteric fever and of mild intermittent, the tongue remains surprisingly clean and natural. As the fever advances the fur increases, the papillæ enlarge and become congested, the dorsum of the tongue becomes dry, usually first in the neighborhood of the *raphe*. At a still more advanced stage, the tongue becomes dry all over, brown, and roasted-looking, while incrustations of brown epithelial debris (sordes) gather upon the teeth, alveoli, and lips; this condition is specially characteristic of typhus and similar fevers, typhoid pneumonia, and generally speaking of the more severe continued fevers from the middle of the second week onwards; it yields very gradually after the crisis, the fur being thrown off sometimes in patches, sometimes more evenly, and the natural moisture returning (see also Chap. xi.). At the stage indicated by the phenomena just described, there has usually been more or less of mental disturbance, and the whole attitude and manner of the patient, as well as his words, indicate a wandering mind and semi-unconsciousness, or even an advance into coma, with great and increasing weakness; the posture being in the more extreme cases absolutely prostrate on the back, with the mouth more or less open, the eyes half closed, and sometimes a film of dried mucus and lachrymal secretion on the conjunctivæ; the pupils being often contracted so as to resemble pinholes, and insensible to light. When associated with profuse sweating, or, even apart from this, with cold extremities (the febrile heat remaining in the central parts of the body), the prognosis is as bad as it well can be in any fever. A very unfavorable sign is a starting or twitching movement of the tendons of the wrists (*subsultus tendinum*), and tremor of the muscles generally; still more unfavorable, if possible, are the movements of the hands described by Hippocrates, and reproduced by countless authorities with more or less conscious imitation for more than 2000 years under the names of *carphologia*, *floccitatio*, etc.: "When in acute fevers, pneumonia, phrenitis (acute delirium), or headache, the hands are waved before the face, hunting through empty space as if gathering bits of straw, picking the nap from the coverlet, or tearing chaff from the wall—all such symptoms are bad and deadly."[1] The peculiar deadliness of such symptoms, it may be remarked, depends upon the fact of their indicating at once two apparently contrasted states of the nervous centres and especially of the basal ganglia and mesencephale, if not also of the medulla oblongata—viz., restlessness, with greatly lowered, if not lost, sensibility to external impressions; unconsciousness, with disturbed excito-motor activity, and almost always with entire absence of real sleep (*coma vigil*); the movements are absolutely automatic, and yet they are continuous, being excited by some purely physical irritation of the motor centres apart altogether from consciousness, and acting feebly through the efferent nerves upon those groups of muscles especially which, in the normal condition, exhibit the most highly differentiated and exquisitely combined movements under the influence of the will. To the same order of phenomena belong the constant mutterings (typhomania or typhoid[2] delirium), or wordless, and sometimes even voiceless, movements of articulation (mussitatio) observed in the later stages of many severe fevers, conveying to the mind of the observer merely the idea of unrest, without the faintest suggestion of meaning or even of consciousness. (Compare sections on Delirium and Sleeplessness.)

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[1] A remarkable contrast to these irregularities of the cutaneous transpiration in fevers is to be found in most cases of diabetes mellitus, in which, with great emaciation and disorder of nutrition and of the urinary excretion, the surface often remains throughout harshly dry and cool, the natural perspiration, even under severe exertion, being suspended. Generally speaking, a dry skin which does not very easily perspire, and maintains an equable temperature, is the sign of a "wiry" frame and of good health. Corpulent *persons*, on the other hand, perspire easily.

The specialties of physiognomic diagnosis bearing on diseases of the chest will be discussed hereafter. (See Dyspnœa, Orthopnœa, etc., Chapter ix.).

In all *diseases of the Nervous system* it is of paramount importance to observe the attitude and bearing of the patient, his manner of answering questions, of putting out his tongue, speaking, eating, handling familiar objects, walking, etc. There should be no hurry in making these observations; sometimes the abnormal facts can be taken in at a glance, as it were; at other times the disease may elude observation altogether, until brought into full view by some particular abnormal act. This applies in a very special sense to disorders supposed to be of the mind, which have often a very distinct physiognomic expression, while in other cases they require to be sought out through tedious processes of detail, amid many difficulties and possible fallacies, or even as underlying positive deception. In all disorders attended with paralysis, tremor, or convulsion, there will be at some time or other visible phenomena affecting one or other of the modes of ordinary activity above enumerated; or there may be deficient power of evacuating or of retaining the excretions of the bowels and bladder. A slight tremor of the lips, and a hesitating utterance, as if the lips and tongue had no grip (so to speak) over the consonants, will, along with a peculiarity in the gait, an unusual stillness in the muscles of expression, and a slight disparity of the pupils, reveal with almost absolute certainty an early stage of one of the most hopeless of diseases—general paralysis of the insane. A similar but more complete absence of facial expression, without any of the other characters just mentioned, unless it be a flaw in the articulation absolutely limited to the labial consonants, will give the key to a more rare, but far less dangerous disorder—double or bilateral paralysis of the portio dura: while a one-sided action of the face and brow, with a permanently open or half-open eye on the side of the paralysis, and a twist of the mouth towards the opposite side, will show forth the much more common, and equally isolated, paralysis of the portio dura on one side only. An open mouth, dribbling saliva, an awkwardly-moving or nearly motionless tongue, with very indistinct articulation, will reveal the labio-glosso-laryngeal paralysis of Trousseau and Duchenne. The *trailing* walk of the hemiplegic patient, in which the weight of the body is supported on one limb, while the other (the paralyzed) limb is either dragged on the ground, or lifted by a movement of circumduction proceeding from the pelvis, and favored by a hitch of the whole body, are signs which can be noted at once, along with the motionless, sometimes rigid, hand and arm of the same side, semiflexed, and with the fingers bent into the palm. The slow, shuffling gait of the true paraplegic, and the staggering, erratic progression of locomotor ataxy ("as if his legs did not belong to him") are equally characteristic, almost at first sight, and easily distinguishable from the limping of hip-joint or other articular disease, and from the reeling, serpentine, plainly bewildered course of the man tending homeward after a debauch, and ready at any time to lie down in the dirt, to save the trouble of further picking his way. More difficult to distinguish from the latter are some forms of apoplexy or of cerebellar disease, of the diagnosis of which, however, it is impossible to treat in this chapter. The wrist-drop of lead paralysis, the irregular manipulations of writer's cramp and other peripheral nervous disorders of the fingers, must also be omitted here, though essentially of the nature of really physiognomic diagnosis. The peculiar jerkings and general "insanity of the muscles" which characterize chorea must also be dismissed with a reference to special articles and treatises; as also the whole subject of tremor, paralysis agitans, and spinal sclerosis.[1]

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[1] Prognostics, IV.; Adams's translation, vol. i., p. 238.

[2] It should be particularly remarked, as necessary for the reconciliation of old and new terms, that the word "typhoid" is not used here in the special and limited sense given to it by Louis and the French school of the present century, as a designation of enteric fever, but in that larger and more general meaning which it had from at least the time of Galen, of typhus-like (τῦφος, εἶδος). Typhus and most of its derivatives, including typhomania, are Hippocratic words, used in a figurative sense, from τῦφος, smoke, as indicating the *stupor* which attends the graver kinds of fever; and, in the case of typhomania, the combination of stupor with restless delirium—exactly the functional contrast referred to above. The etymological facts are interesting, as showing how, even in the most remote period to which the literature of medicine extends, clinical phenomena which only receive their physiological interpretation from modern science were, nevertheless, sometimes very exactly noted.

Reverting to the disorders which seem to have more relation to the mental functions, it may be affirmed with truth that almost every distinct type of insane aberration has its peculiar physiognomy, from the extravagant and excited gestures, shouts, and destructive violence of the maniac, to the muttering and moaning of the victim of pure melancholia, nursing his secret sorrow alone; or the mindless, speechless, slouching, purely animal characteristics of the extreme demented patient, pushed about almost like a chattel by his keeper, without spontaneity, and only capable of being excited into a temporary sense of apparent enjoyment by the sight of food, or of tobacco, or perhaps, in some instances, by objects of sexual desire. And within these divisions lie almost endless varieties; *e. g.*, the hysterical maniac, incoherent, extravagant in speech, laughing and weeping by turns, erotic and shameless in her behavior at times, and with lucid intervals, it may be, of long duration; the harmless and good-humored, half-demented creature, pleased with every slight attention, easily amused, and always busy with some mechanical or artistic occupation—knitting, or drawing, or writing long snatches of nonsense in verse, or playing the fiddle; the suspicious monomaniac, who follows you with his eye at every turn, grumbles and mutters audibly his suspicions, and would no doubt at times lay violent hands on you if permitted; the egotist, who adopts the manner and style of the Emperor of India, or the Queen of Sheba, or of more sacred characters than these, or, it may be, of the Creator of the Universe! Each of these insanities tends to produce, as it were, a physiognomy for itself; the whole physical habit becomes so moulded upon the prevalent delusion, that it may almost be said that a glance at the patient and his surroundings gives some considerable insight into the special character of his mental unsoundness. Still more curious, because more inexplicable, are the physiognomical individualities that lie within the apparently narrow bounds of idiocy and imbecility. There is the congenital idiot, often dwarfish in body and infantile in expression and habits, sexually undeveloped, with a Λ-shaped palate, and one or more apparently accidental bodily deformities, living the life almost of an infant: the *crétin* of the Alpine valleys, goitrous and otherwise physically deformed; the epileptic idiot; the hydrocephalic idiot; the microcephalic idiot; the paralytic idiot. Of all these, and of other varieties, the physical and physiognomic characters have been admirably described by Dr. Ireland in a classic work recently published. (For further details see also Chapter viii. on Insanity.)

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[1] These subjects are discussed in special sections of Chapters v., vi., and viii. Consult the index for the names of the various diseases and symptoms referred to. See also in particular the sections on Speech, Walking and Balancing, Twitchings, etc.

As in the insane and the imbecile physiognomic diagnosis assumes a special importance, from their inability, in many instances, to give a coherent account of themselves, so it may be said that in *infancy and in early childhood* the physiognomy of disease constitutes by far the most important aspect of diagnosis considered as a whole, unless in the case of positive physical signs directly bearing on the state of the internal organs. If an healthy infant of from four to six months is carefully studied from the medical and physiological point of view, it will be found, of course, to have increased considerably both in stature and weight since its birth;[1] but in addition to the mere growth and increase of bulk a skilled eye and touch will easily determine the fact that the muscular structure of the limbs have acquired much greater firmness, plumpness of outline, and with these more apparent spontaneity and definiteness, so to speak, of physiological activity. The cause of this change is partly the constant exercise of the muscles themselves, and partly the rapid development of the nervous centres presiding over the muscular movements. As yet, the movements are mostly automatic; there are few, if any, purpose-like acts of prehension with the hands, for instance, until nearly six months old, although an object conveyed into the grasp is held, just as the nipple is held when placed between the lips. There is, however, a constant activity of the limbs, both upper and lower; and a gradual education of all the voluntary muscles, including those of expression and voice, to the functions afterwards to be performed under the influence of the intelligent will. The child is obviously a sentient and emotional being, and one of the half-conscious impulses which guide its movements when awake is the positive delight which it experiences in giving to every individual voluntary muscle, down even to the smallest of those which move the toes and fingers, a fair share of daily and hourly exercise. Watch an infant four, or six, or eight months old, crowing with the mere physical enjoyment of perpetual motion, kicking its arms and legs about as it is removed from its bath and lies naked in its nurse's arms, and you will be compelled to recognize the force of this healthy, but apparently, as yet, unintelligent instinct. It is the same instinct as, in the more developed system of the kitten at a like or yet earlier age, leads it to chase its own tail, and to do a thousand pranks that seem aimless, but are in fact surely guided towards a definite end in the evolution both of the bodily and the mental faculties—viz., the instinct of *Play*.[1] Next to the yet more absolutely necessary, and therefore earlier displayed, instinct of suction, this is the faculty that, more and earlier than any other, rules the life and determines the physiognomy of the infant. We have seen, in the graphic words of Sir William Jenner, how this power of spontaneous and wholesome bodily movement is disturbed in the ricketty cachexia. It might be added that in almost every serious disease of early infancy and childhood it is possible, by studying carefully the relation of the spontaneous movements to each other, and to the attitude and expression of the child, its cries, smiles, inarticulate noises, its color, state of general nutrition, behavior in sleep and in waking, to arrive at a seasonable, and often a perfectly just, conclusion, as to the general nature and locality of the disease. If there is paralysis in any limb; if the spine or any individual joint is weak or pained; if the breathing is obstructed; if the abdomen is pained and tender, or distended; if the bony skeleton is too yielding, and does not afford the requisite support, or affords it only with pain; in each case there is a typical departure from the normal attitudes and modes of activity, as displayed in the waking moments; or from the happy, quiet sleeping existence of the healthy infant. Of course it is absolutely necessary that the survey should be, as far as possible, complete and deliberate; do not, therefore, confine the observation to the face, or be satisfied with feeling the pulse, and looking at a bundle of clothes. Note the color of the cheeks, the heat of the skin all over the body, the presence (especially in sleep) of twitchings, startings, sudden catchings of the breath, or breathing with effort and with imperfect expansion of the chest; observe the descent of the diaphragm, the elevation of the ribs on both sides, the state of the abdominal wall and its contents, the state of the fontanelle, the size of the head as compared with the body, and any abnormal flattening of the vertex or projection of either frontal region; the fulness of the veins of the head and neck, the presence or absence of local, or undue, perspirations; observe if the eyes are completely closed, as in healthy sleep, or half-closed as in some febrile and cerebral diseases; if the child buries its head in the pillow, or has the hair worn away, as it were, on some parts of the head, or has the neck twisted backwards, and stiff; or, at a more advanced age, if he grinds the teeth, or picks the nose habitually; if the nostrils are dilated in inspiration, and if there is any noise in the larynx, or in the chest; if the surface shows any eruptions, or the mouth and anus any mucous patches or condylomata, or other evidence of syphilitic disease; if the muscles are flabby or well-nourished; if the abdomen is retracted, or tumid and resistant, or soft, natural, and easily manipulated. All or most of these observations can be made even in a sleeping child without disturbing it too much; but of course it will be best to take them in the order most convenient for this end. The pulse and respiration should also be numbered, if possible, during sleep. Other observations, as on the mouth, gums, teeth, tongue, throat, nostrils, ears, as also all detailed physical explorations, should be postponed until all the information that can be procured during sleep and waking from these physiognomic data has been carefully gathered and noted, and until some questions as to previous history have been put.

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[1] According to Quetelet, an infant grows in length, nearly seven inches and a half during the first year of life; in the second year, only half of this amount; and in the third year, only one-third of it. From the fourth or fifth year of life the increase is a little over two inches (56 millimetres) annually till the age of puberty.

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[1] Dr. John Strachan has discussed the physiological and educational aspects of this subject in an admirable little treatise—"What is Play?" Edinburgh, 1877; a work which may be recommended to the perusal of every student and practitioner of medicine.

Most of the inferences to be drawn from the preceding observations will be commented on in other parts of this book. We may here, therefore, fitly close our chapter on the physiognomy of disease.[1]

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[1] For consultation, by those who may wish to follow out the medical literature of this subject, the following authorities may be referred to, with a caution, however, in the case of some of them, sufficiently indicated in the opening paragraphs of this chapter: Galen on the Temperaments, especially in his treatise "De Temperamentis (περὶ κράσεων), and elsewhere in many places, for which see the general index, Kühn's edition, vol. xx., p. 588. For a more brief résumé, see Paulus Ægineta, translated by Adams, vol. i. pp. 84–86; Lavater, "L'Art de Connaitre les Hommes par la Physionomie," Paris, 1806–7; Baumgaertner, "Physiognomice Pathologica," with Atlas in folio, 1839; Sir Charles Bell, "Essays on the Anatomy and Philosophy of Expression," London, 1824, 6th edit. 1872; Laycock, Lectures in "Med. Times and Gazette," 1862, vol. i.; Corfe, "Med. Times and Gazette," 1867, vol. i.; Charles Darwin, "The Expression of the Emotions in Man and Animals," 1872, and later editions—a work full of original suggestion and philosophical research, though not specially occupied with disease, or with its physiognomic expression.

CHAPTER II.

EXAMINATION AND REPORTING OF MEDICAL CASES.

CASE TAKING.

In examining cases brought under his notice a physician is guided by the circumstances in which he finds the patient, and by his knowledge and experience of the condition with which he has to deal, and so one case is approached in one way, and another in quite a different manner. No one method can actually be applied to all cases; indeed no one method could possibly be the best if used indiscriminately. When a patient is gasping for breath and scarcely able to speak, we must reserve our questions for the most important points. When a patient is delirious, muddled, or obviously unreliable, it is vain to try to procure from him a connected statement of his history and his sensations. If actually insensible, or in a fit, we dare not delay our examination of his condition, so far as this can be ascertained, simply because we would prefer to await the arrival of information as to the previous history or the mode of attack; such delay (apart from all practical questions of treatment) might deprive us of the only opportunity of ascertaining the nature of the ailment. Nor would a physician explore the family history of a person with scabies in the same way in which he would investigate this part of a phthisical case; his question directed to the patient with scabies on this matter would probably be limited to a few pointed inquiries to ascertain the infectious character of the eruption, from its presence in other members of the family. Usually we begin by inquiring more or less fully what the patient feels to be wrong; this serves to direct the first part of our physical exploration of the organs, and the mischief detected there often sends us back to inquire into the exact way in which the illness began, the previous health, and the family history; certain points thus ascertained may demand a renewed examination of the organs, or the exploration of other parts.

In urgent cases we seize upon the severest symptoms, the dyspnœa or pain for example, and try to get the greatest information attainable at the least cost to the patient, sparing him as much as possible the fatigue of questioning or of physical examination, according as the one or the other causes the greatest annoyance or danger, filling up the gaps from the information supplied by the attendants.

When there are obvious features of capital importance, such as jaundice, febrile eruptions, bronzing of the skin, pulsating tumor in the neck, serious hemorrhages, profound anæmia, and the like, we often begin with these facts, and having ascertained their origin, proceed in our inquiries to the other parts of the case and its earlier history.

When the illness is obscure, a more systematic examination of all the organs and functions of the body, and an equally careful inquiry into the history of the patient and his family, may be required to unravel the difficulties.

In reporting cases, likewise, very different methods are pursued by the same physician, according to the varying peculiarities and the different points of interêst and importance in each case, and also according to the object he has in view in making the record.

The student in the medical wards, however, is not placed in exactly the same position. The cases assigned to him for reporting are usually selected by those in charge of the patients, and they seldom fail to warn the student when prolonged physical examinations would be dangerous, or when special parts of the investigation must be omitted or passed over slightly. To the student, therefore, a more uniform plan can be recommended, and it is the more useful to him, as without some method to guide him he is apt to omit noticing various important features of the ailment. This may arise from forgetfulness, and from there being so many points which have to be investigated; but the student is likewise apt to omit important parts of the inquiry from supposing that the indications of disease found by him in one part are sufficient to account for the whole illness; having found, for example, the presence of albumen in the urine and other evidence of renal disease, the beginner may never think of examining the heart, and may set down a distinct loss of vision to some accidental coincidence.

It is in the examination of the actual state of the patient (status præsens) that the student chiefly requires the assistance of some method in his investigation of the various symptoms and physical signs. The following plan is recommended by Professor Sanders, who has devoted much consideration to this subject. A division into "Anatomical Regions" and "Physiological Systems" is first made, as it assists in reviewing the signs and symptoms of disease; by dealing with these regions and systems methodically we can detail the "signs" and the "symptoms" separately, under each system; we thus save allied facts from being divorced from each other, and yet prevent the confusion which is apt to arise from mixing up diverse symptoms and signs together. The "Regions," also, can be combined with the "Systems," by classifying the systems under the regions according to the situation of their principal organs.

A preliminary division which is found convenient is to separate the "EXTERNAL" from the "INTERNAL." Under the *External* portion may be included those obvious features which go to form the "physiognomy of disease," or refer to the peculiarities of the patient. The temperature of the body, although really an internal phenomenon, is usually judged of by the feeling of the skin, or by the application of a thermometer to the axilla; it is thus included under this department. The conformation, weight and muscular development, the apparent age as compared with the real age, the expression and complexion of the face, the presence of dropsy, the posture, and the like, come in here. An examination of the skin for eruptions of any kind, and a survey of the limbs and joints, for any signs of disease, likewise fall to this portion of the investigation. Such facts as glandular enlargements may either be stated in this connection, or in a more detailed manner in connection with the regions where they are noticed; the extent of these affections usually determines our choice in such cases.

The *Internal* examination may be subdivided into the "Regions" of the HEAD, THORAX, and ABDOMEN. The *Head* includes the great organ of the "Nervous System," and as the spinal and peripheral nervous system cannot well be separated from the cerebral, in any preliminary examination, we include all parts of the nervous systems in this regional division. The *Thorax* contains the great central organs of the "Respiratory" and "Circulatory" systems, and as these cannot be duly examined without considering the peripheral portions, they also are dealt with all together under this region. The *Abdomen*, likewise, as a region, supplies us with two systems—the "Digestive" and the

"Genito-urinary"—for a complete exploration in their whole extent.

It is supposed to be an advantage to begin always with the *External* part of the examination, as some points of it are otherwise apt to be overlooked; it can usually be rapidly dismissed unless, indeed, it constitutes the principal part of the case. In the *Internal* regions Professor Sanders recommends us to deal with the systems whose great organs are contained in the same cavity before proceeding to the others; to discuss the heart and lungs in sequence, for example, before proceeding to the digestive and genito-urinary systems and their organs contained in the abdomen.

We begin with the system which seems from the history or from the general aspect of the case to be one most essentially affected, and we also, of course, consider it in much fuller detail. Hospital cases are usually so far prepared for the student by the previous record of the temperature and the preservation of the urine and expectoration for his inspection.

"If we find orthopnœa, general anascarca, and distended jugular veins, we begin with the circulatory system.

"If we find purulent expectoration, emaciation, and clubbed finger ends, we begin with the respiratory system.

"If we find albuminous urine and pale puffy countenance, we begin with the urinary system.

"If we find jaundice and protuberant abdomen, we begin with the digestive system.

"If we find paralysis or convulsive twitches, we begin with the nervous system, and so forth." (Dr. William Roberts.)

These anatomical and physiological divisions could never, however, preserve us from making serious omissions in our reports, unless each detail in each system were investigated with an absurd and, indeed, a reprehensible completeness. The manifestations of disorder in the various systems often appear in the most unexpected quarters. These points can only be learned by a varied experience of morbid conditions, such as the beginner cannot be expected to possess. The detailed description of the symptoms dealt with in the sequel may supply, to some extent, from the experience of others, the want thus felt by a beginner, so that when he comes upon any of these symptoms he may know how to pursue the investigation in its various ramifications, and to estimate to some extent the bearing of the facts on the diagnosis.

As an indication of the points to be investigated under each heading, and the order in which the inquiry may be taken up, the following tabular statement is appended. It is used by Dr. Sanders in his *clinique* at the Edinburgh University:—

DISEASE. RESULT.

PRELIMINARIES—1. Name. Age. Occupation. Residence. Date of admission. No. of Bed and Ward.

2. Complaints, as stated by patient, or reported by friends; or obvious morbid conditions, *e. g.*, Jaundice.

3. History of present attack; of previous health. Family history. Social history.

PRESENT CONDITION—

Regions A, External.—1. General condition as to development, height, weight, muscularity, posture. 2 Expression of face. 3. Integument; temperature, perspiration, eruptions, tumors, &c. 4. Condition of limbs and joints.

Regions B, Internal.
Commence with the region and system affected, and describe all the systems of a region before going to another.

HEAD, NERVOUS SYSTEM—
Peripheral—Nerves; motion, sensation, special senses.
Central—Brain and spinal cord; intelligence, sleep, headache, &c.

THORAX, RESPIRATORY SYSTEM—
Peripheral—Nose; action of alæ nasi. Larynx; voice (laryngoscope). Trachea. Cough.
Central—Lungs and pleura.
Examination of these as to—
(*a*) *Symptoms*—Number of respirations, dyspnœa, pain, cough, expectoration, hæmoptysis, &c.
(*b*) *Physical Signs*—Inspection, palpation, percussion, auscultation.

THORAX, CIRCULATORY SYSTEM—
Peripheral—Arteries; veins, &c. Pulse, number, character, variations.
Central—Heart, and large vessels within thorax.
Examination of these as to—
(*a*) *Symptoms*—Cardiac dyspnœa, palpitation, pain at precordia, syncope, angina pectoris.
(*b*) *Physical Signs*—Inspection, palpation, percussion, auscultation.

ABDOMEN, DIGESTIVE SYSTEM—
Symptoms—Teeth, tongue, deglutition, hunger, thirst, digestion, vomiting, bowels.
Physical Signs—Inspection, &c., of abdomen. Tumors. Liver and spleen.

ABDOMEN, GENITO-URINARY SYSTEM—
  Frequency of micturition, pain, &c.
  Urine; amount in 24 hours, sp. gr., color, reaction, odor, deposits, chemical qualities.
  Menstruation, lactation, pregnancy.

DIAGNOSIS—Full; including causes and all the lesions and disorders arranged in order of importance and succession.
PROGNOSIS—Immediate and remote.
TREATMENT—Principles, indications and special prescriptions.
PROGRESS AND TERMINATION.

THE PERSONAL HISTORY.

The History of the illness under observation should, as a rule, be taken separately from the record of the previous health of the patient. We begin by seeking to know what symptom, or combination of symptoms, or what circumstance has brought the patient into the hospital, or made him seek medical advice. The points regarded by the person himself as important are thus obtained, and should always be recorded at the beginning of our reports, even although they may not seem to us the most essential features of the illness. The subsequent course of the case has often much light thrown upon it by this record of these early indications, for the patient may feel the importance of certain things which may be overshadowed in our minds by considerations based on our theoretical view of the disease.

Taking these leading complaints as our basis, we try to discover the date at which they appeared, the order and sequence of the symptoms, and the relative severity of the different parts of the illness at different times, and particularly the date at which the disease laid the person aside from work, and confined him to the house, or to his bed, as the case may be. Having traced the date and origin of the present complaints, we seek to ascertain if they arose in the midst of health, or if they sprang out of some previous illness or general derangement. If it appears that the patient regards the present trouble as definitely originating in some other illness, or if from the known facts of disease this relationship seems probable to ourselves, we begin our history of the present illness with an account of the former one out of which it has seemed to spring. But if the present illness cannot be well defined by a date of previous health, or if the history is entangled in a long story of former disease or general delicacy, it usually conduces to simplicity to begin by taking the history of the present aggravation of the condition separately, and to include the former part of the illness in the account of the previous health of the patient. For example, if we find that dyspnœa, dropsy, etc., constitute the chief complaints of the patient, if these have existed for two or three months, and seem to date from a *second* attack of rheumatic fever, six months ago, we begin with this *second* attack of rheumatism, we trace the sequence of events from it, and reserve a detailed account of the *first* rheumatic attack, and any former illness, for the other part of the case which deals with the previous history of the patient. But if we find a serious hæmoptysis, or a violent pain in the chest, or severe headache and vomiting to form the obvious and urgent complaint of a patient on admission, we deal first with the origin and course of these, even although it may be certain that the patient has long been the victim of chronic lung disease. Having traced the history of these urgent features of his complaint, we go back and try to unravel the tangled web of chronic ill health in all its various manifestations.

In the case of children, and especially of young children, we may often save time by ascertaining from the mother the point in the child's age up to which it was regarded as healthy. We may note in passing whether the child was suckled, or how it was fed, when it was weaned, when dentition began, and when the child began to walk. From this period of health we trace all its illnesses onwards, up to the present, even although there may not be much connection between them. If, again, the child has been delicate from birth, or troubled with many recurring illnesses from the beginning, it is equally important to procure a connected history of all these, so as to judge of the child's prospects in the present attack of whatever kind this may be.

In procuring the history of an illness from the patients or their friends, we should try to get the facts as known or observed by themselves, rather than mere names received from others or theoretical conceptions, such as "inflammation," "brain fever," and the like. Calling an illness "Rheumatism," for example, may quite mislead us in the history of cases which really depend on spinal meningitis or locomotor ataxy. We must try to learn from the patient or his friends, in such a case, what evidence there was of the so-called rheumatic attack, whether it was associated with swelling of the joints, where the pain was localized, whether there was feverishness, and so forth. The story of an inflammation of the chest or lung must, likewise, be recorded, with such additional information as can be obtained; this may tend to confirm or to throw doubt on the name given. Sometimes, however, when the name of the disease is given with some precision, and stated on the authority of some medical man, or in connection with some hospital, we may accept the name of the disease, adding in our notes the authority on which we do so.

In following up the sequence of symptoms we also aim at representing in our report the facts of the illness as actually experienced and complained of by the patient, apart from all theoretical views; some patients are very fond of importing these into their narrative. The reality or severity of certain symptoms may often be usefully indicated by stating special facts, for example, in a case of swelling of the belly, that the skirts had to be widened, or that the trousers could not be buttoned; or in a case of weakness, that the person could not walk across the floor without assistance; or in the case of pain, that the patient could get no sleep, or that he screamed out, or fainted in connection with it. Details like these guide our estimate of the value of the history as derived from the patient. We must, likewise, make use of our own knowledge to check the patient's history, particularly in putting special questions to make sure of the real facts when the account seems improbable or incredible. We may also, after getting the history from the patient, inquire as to whether certain symptoms were not present, as he may have forgotten them, but we must, if possible, avoid putting ideas into our patients' minds; leading questions must be sparingly used, or at least reserved for the end of the interrogation, and to bring out negative points in the case with clearness and precision.

The history of the previous health should be, in part, of a general kind, such as patients can readily supply; the dates and durations of previous illness should, as a rule, be specified, as well as the names of the diseases; the general state of the strength, and the date of any deterioration in this respect must likewise be noted. But in addition to this general sketch we must often put special questions as to special points, which the patient might otherwise overlook. Thus, in cases of heart disease, we always inquire about rheumatism; the indications of this, especially in childhood, are often so slight that they might easily be missed without some special inquiry. In cases of spinal paralysis, aneurism, and some other affections, we must inquire for any strain or injury, and we note its date and the exact manner in which it happened. We must often, indeed, go back upon the history of our patients, especially as regards this earlier portion of it, after the examination of the case in various ways has guided us so far to the diagnosis. Sometimes, moreover, as described in the section on "Family History" (see p. 65), we must search about in our questions for diseases allied to the one suspected to exist, using popular names likely to be known by the patient or his friends.

The inquiry as to previous venereal diseases is often important, but must be approached with delicacy in the case of women, especially those who are young and apparently respectable. We may often gain some information as to syphilis in an indirect way, by inquiring for a history of sore throat, skin eruptions, nodes, and falling out of the hair; or, in the case of those who have had children, whether any of these were born dead, whether there had been any miscarriages, whether the children born alive had eruptions on their buttocks, snuffles, or the like. We can seldom place much reliance on the mere denial of syphilis, but with tact in approaching the subject we can often obtain the history and date of infection. The history of gonorrhœa is important in certain arthritic affections, and particularly in cases of urinary irritation, as, when stricture follows it, the bladder and kidneys are often involved. Syphilis has to be considered in the history of a multitude of diseases—skin diseases, nervous affections of various kinds, disease of the liver, amyloid degeneration of the liver and kidneys, aneurism, and other forms of disease of the bloodvessels, laryngeal ulceration, &c.

Social History: Habits.—Certain points not of a purely medical character are usually inquired into, in addition to the bare facts as to age, occupation, residence, marriage, &c., which are taken in all cases for the routine purposes of the hospital records; special points must often be searched out. The age may suggest a comparison between the alleged and the apparent age. The occupation may have to be scrutinized as to the special peculiarities of the employment, and the exposure to evil influences known to beset certain trades; former occupations sometimes explain certain ailments. The residence may raise questions as to the healthiness of the locality, its freedom from certain diseases and its exposure to others; the accommodation in the particular house may also have to be investigated, as regards its cubic space, its water-supply, drainage, &c.; former residences, exposure to malarious influences, to tropical climates, &c., have often to be inquired for, and the results must in many cases be recorded even when they are negative. The effect of marriage, its date, and the number of children born alive and dead must also be recorded; in the case of women the number and date of miscarriages and abortions should also be noted in some part of the report.

The kind of food habitually used often supplies very important light as to certain diseases: the use of tea in excess, or to the exclusion of milk, vegetables, potatoes, &c., often explains scorbutic, nervous and dyspeptic disorders. The excessive use of tobacco is suggested in cases of cardiac palpitation or pseudo-angina pectoris, dyspepsia, dimness of vision, and other nervous troubles. The use of alcoholic stimulants must be inquired into in cases of liver disease, renal affections, dyspeptic complaints, and in all diseases characterized by delirium, with or without much fever; the history of any previous intemperance often explains the high delirium present, and has great importance in the prognosis and the treatment. The form of alcohol used, whether beer or spirits, is sometimes a matter of importance; we must likewise ascertain whether a somewhat excessive use of these was of daily occurrence, or whether the excess was only during an occasional outbreak in the course of weeks or months.

The regular use of other stimulants or sedatives, especially opium, chloral, and chloroform, must sometimes be inquired into.

The practice of masturbation is to be inquired for with great caution, as we must avoid suggesting the idea of evil to those whose minds are free from any such notions, but in certain cases of epileptic seizures, in certain forms of cardiac palpitation, and in some cases of nervous prostration and spermatorrhœa the questions must be put with clearness in the interest of the patients, for their warning, quite as much as for the benefit of the diagnosis. Excessive venereal indulgence, whether within the married state or not, is often responsible for nervous disorders, spinal paralysis, locomotor ataxy, and other less definite forms of disease. These effects are more common in the male than in the female.

FAMILY HISTORY.

The importance of family history in throwing light on the tendency to special disease is well shown in life insurance studies. This inquiry embraces a note of the age of the parents and of the brothers and sisters of the patient, and of their state of health if alive, of the ages at which any such relatives may have died, the nature of the illnesses they have had, and the diseases which caused their death. Inquiries as to other relatives are occasionally important, especially when the number of brothers and sisters is small, or the information regarding them obscure; the grand-parents, and the uncles and aunts of the patients, on both sides, are the most important in this respect. In going beyond these to half-brothers and sisters, to nephews and nieces, to cousins, or even to the children of the patient, we necessarily introduce complications from marriage; these, however, may sometimes be allowed for in summing up the inquiry.

Now all this information can seldom be obtained with any feeling of accuracy, and in hospital practice the deficiencies are enormous. We should begin by getting the bare facts as to the size of the family, the ages of those living, and the diseases and ages of those who have died. In some cases, where we can interrogate the mothers of children, with suspected syphilis for example, we should also try to obtain the number and dates of the miscarriages and still-births, ascertaining whether these occurred before or after the birth of the child under consideration. The further prosecution of the inquiry must turn upon the facts thus elicited, and upon the other facts discovered in the investigation of the illness. Hence we often revert to the family history at the end of the inquiry, to bring out information on special points as to the health or history both of the living and dead. When the causes of death alleged are doubtful or unsatisfactory, we may sometimes judge for ourselves from the facts of the illness supplied by our informants. In particular, we must receive with great reserve the deaths set down to "Teething," "Change of Life," "Childbirth," "Cold," "Inflammation," &c. Many deaths are set down to childbirth or change of life although they were really due to phthisis, which had led, perhaps, to suppression or irregularity of the menstruation at an early age, or which had run a rapidly fatal course after childbirth. Regard should be had to the age at which such a death occurred, how long the confinement had been survived, how long the weakness had lasted, and whether it was associated with cough, spitting of blood, or other suspicious symptoms. In these doubtful cases, inquiry as to the collateral branches of the family is important—*e. g.*, if a patient's mother is reported to have died from a cause in doubt we may search with advantage into the history of the maternal uncles and aunts. "Inflammation of the Lung" and "Pleurisy" must be scrutinized in the same way, especially if other deaths occurred from phthisis or pulmonary affections in the same family; if either pleurisy or pneumonia proved fatal after a prolonged illness, we may suspect that these were allied to phthisis, or that some scrofulous tendency existed in the constitution of the victim. The name of "Bronchitis" also covers many deaths from phthisis: the age of the subject, the duration of the illness, and the occurrence of lividity, dropsy, &c., may sometimes guide us. "Worm Fever," "Intermittent Fever," "the dregs of the measles," and some other terms of this kind are often merely popular names for tubercular disease. Sudden deaths ascribed to apoplexy are to be investigated as to whether the death was almost instantaneous or whether the illness lasted at least some hours: in the former case cardiac or aneurismal disease is more probable than apoplexy; apoplectic attacks in early manhood, with one-sided paralysis, are to be suspected as due to syphilitic, cardiac, or renal disease. In fact, the name must be regarded, unless substantiated by good evidence, as of only little account; all the knowledge we possess of the nature of diseases and their relative frequency at particular ages, and in particular countries, must be brought to bear on the scrutiny, and some familiarity with the names of diseases in common use among the poor is also of much value in hospital inquiries.

In inquiring into the illnesses which the members of a family may have had, it is desirable to suggest various diseases allied to the one known or suspected to exist in the patient, using for this purpose various names, so as to meet the limited knowledge of our informers, and also to refresh their memories. Thus in regard to scrofulous diseases, we ask for swollen glands or "waxen kernels," or runnings in the neck, diseases of the spine and other bones, bad joints, white swellings or "incomes," as they are termed in Scotland, disease of the glands of the bowels, water in the head, consumption of the lungs, or decline, or weakness of the chest with spitting of blood, and so on, we may in this way get at the facts when a more general question fails. It is wise, also, in many cases to avoid disagreeable words, such as scrofula, in the first instance at least, as many people are so annoyed at the suggestion of such affections being in their family that they feel shy of giving any detailed information. In inquiring for a family history of cancer, we should likewise be chary of mentioning this dreaded name, at least if our patient's disease is only of doubtful malignancy, trying rather to get our informants to volunteer statements on the subject, and searching for the information wanted under the names of growths, tumors in the breast or elsewhere, disease of the liver, stomach, or womb, with wasting, jaundice, dropsy, floodings, &c.

We must further bear in mind, in these inquiries, the variations of allied diseases which appear in different members of the family, and in different generations; by asking for such by name we often refresh the memory of our informants. Heart disease, rheumatism, chorea, psoriasis, and some other cutaneous affections, and perhaps renal concretions, and emphysematous bronchitis, appear to replace each other in different members of the same family. The scrofulous group has been already referred to. The neurotic group includes the various forms of neuralgia, epilepsy, hypochondriasis, hysteria, and insanity; apoplexy and hemiplegia may (perhaps doubtfully) be included in this group, their hereditary character seems rather to be associated with vascular disorders. Gout, disease of the liver, contracted kidney, renal calculus and gravel, and angina pectoris form another allied group; and these have also some affinity with the disorders connected with arterial degenerations. Syphilis, which, of course, has marked hereditary characters, assumes such a multitude of forms as to preclude enumeration, but the tendency is for such syphilitic diseases to fail in the course of time from early death or sterility. Abortions, still-births, early deaths in infancy associated with cutaneous eruptions on the buttocks, and with snuffles, are important in many family histories; nervous deafness, opacities of the cornea, notched teeth, epilepsy, and imbecility are occasional manifestations of the same disorder in those children who survive; in adult subjects who have acquired syphilis we must either put the question of infection directly or investigate their symptoms and condition when the question of syphilis is important in the family history we are studying.

Although family history is chiefly useful in determining the tendency to certain chronic and constitutional affections, or to premature decay of the individual or of certain organs, we find, likewise, a tendency in some families to special fevers—enteric fever, for example—and even to certain degrees of severity or to special complications—as intestinal hemorrhage—and this may guide us at times, especially in prognosis. The hemorrhagic diathesis itself is sometimes clearly hereditary.

But, supposing we have fairly collected all the information above indicated, certain precautions are required in drawing our inferences. These are due to hereditary diseases missing at times the parents of our patient, or even the whole generation; or to the diseases in question only appearing at ages beyond those available in the study of our patient's history; or to the members of the family, who might have been affected, having been cut off by accident or by what may be termed accidental disease (fevers and many acute diseases). A large family, with all the living members grown up to middle or advanced life, should show pretty clearly the tendency of their family constitution, but even then cancer, for example, is so notoriously disposed to appear at the later periods of life that it may be absent from the family history at the time we are in search of it. A child may die of cancer supposed to be quite unknown in the family till perhaps its parent dies of the same disease many years later. This defect might be supposed likely to be supplemented by the history of the uncles and aunts, or of the grand-parents or the grand-uncles and aunts of our patient; but there is first of all the difficulty of getting precise information, and even then, unless the numbers be large in such families, we may readily miss the evidence of a family taint. In tubercular disease, likewise, especially in children, the family tendency may not have had time to manifest itself at the date of our inquiry. The number and ages of those living come in here to enable us to guess, as it were, at the probabilities of such a tendency having had time and opportunity to manifest itself, if really present. A deceptive appearance of soundness in the family history may sometimes arise from there being no account of deaths or illnesses connected with the suspected disease, when really from smallness in the number of the family, or from deaths due to fevers, &c., no opportunity was allowed for the disease to show itself. Such a family history, although not "bad," is not "good;" it is defective in its evidence. In a larger family, again, a stray death may have occurred from phthsis or rheumatism, due, perhaps, to exceptional exposure or unfortunate modes of life, although no great tendency to such disease existed in the family. We must, therefore, consider all these points in trying to form a sound judgment.

CHAPTER III.

TEMPERATURE—PULSE—GENERAL SIGNS OF PYREXIA.[1]

TEMPERATURE.

An increased heat of the body is one of the oldest and most widely recognized signs of fever. It may be estimated, roughly, by applying the hand, or perhaps the back of the hand to the surface of the patient's body, selecting some of the sheltered parts, such as the axilla, the groin, and especially the abdomen. It must be borne in mind that a certain coldness of the extremities and of the exposed parts may coexist with a great elevation of the temperature in the interior of the body, and even in the axilla or groin. The variable temperature of the observer's hand, moreover, must be remembered as a fruitful source of fallacy, so that when we aim at accuracy in determining the degree of pyrexia, or at certainty in pronouncing its absence, we must have recourse to the thermometer.

Clinical thermometers should be sensitive, and should have the bulb of such a size and shape as to be adapted for introduction into various parts of the body. The graduation should be on the stem itself. Accuracy in the instrument is, of course, desirable in all cases, and is especially important if any great deviation from the usual range of temperature happens to be discovered. Certificates of accuracy, or of the amount of error in the scale, may be obtained by sending the instruments to be tested at Kew Observatory. It is very important to have the observations made with the same instrument, in the case of a given patient, as in this way, although there may be some slight error in the instrument, the changes in the patient's temperature, noted from time to time, are but little affected by such errors; the *variations* in a patient's temperature, from time to time, are usually more important in the case than the absolute height of the reading within half a degree on either side. If the self-registering maximum thermometer be used, care must be taken to shake down the index below the probable temperature of the patient, before it is applied; if an instrument without any registering index be used, care must be taken to read it *in situ*. In applying the thermometer to the *Axilla*, the following points must be attended to: if there be much sweat, the skin should first be wiped dry; the bulb should be introduced deeply into the axilla, under its anterior or pectoral fold, and the arm must be kept close against the thorax; it is sometimes a good plan to make the patient hold the arm in position by means of his other hand, or by lying slightly on the arm during the observation; strong muscular effort to hold the arm by the side is apt to cause a hollow in the axilla, and so to remove the soft parts from the bulb of the thermometer. We may, however, require some one to hold the instrument in position if the patient has not strength or intelligence enough to keep the arm closely applied; care must be taken that no folds of the underclothing interpose between the bulb and the skin; it should also be seen that the instrument does not slip down or project behind and beyond the axilla. *The thermometer must be left in position till the mercury maintains the same level for two or three minutes.* The time required for an accurate measurement of the temperature in the axilla depends on this cavity requiring to be kept closed long enough for it to reach its maximum heat, as this may have been reduced by exposure to the air; it is clear, therefore, that a very different length of time may be required in different observations; the only accurate method is to see that the maximum is really attained, as judged by the stationary position of the mercury; a stationary position for two or three minutes is found to be sufficiently accurate for ordinary clinical purposes. When self-registering instruments are intrusted to unskilled persons, who cannot read the index, fifteen minutes may be named as a proper time for the application of the instrument. If the arm be kept closely applied to the side for fifteen or twenty minutes *immediately before* the thermometer is introduced into the axilla, the necessary time for the actual observation may be shortened. Heating the bulb of the instrument beforehand, to a temperature near the blood-heat, is desirable if the weather be cold or the bulb be large, but it does not materially lessen the time required for the observation.

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[1] Various works on the practice of medicine, on diseases of children, and the acute infectious diseases must be consulted for details: See especially Aitken (as regards temperature); Vol. I. of Reynolds's System of Medicine; Murchison on Fevers, &c. Wunderlich in his Medical Thermometry, and Burdon Sanderson in his Handbook of the Sphygmograph, deal with these subjects in detail. The Sphygmograph is discussed in most of the recent treatises on Physiology. Galabin's little pamphlet on Bright's Disease is also valuable, and Sphygmographic tracings are now given in various works or sections of works dealing with heart disease. See also Mahomed's Papers in *Medical Times and Gazette*, *—1872, Vol. I.*

If the *Mouth* be used for testing the temperature, the bulb should be placed under the tongue and the lips kept shut, the breathing being performed through the nostrils. The mouth resembles the axilla in being sometimes open and sometimes shut, and similar remarks apply to it as to the axilla. The mouth may often be used with advantage for testing rapidly the temperature, in an approximate manner, in dispensary or private practice. Care must be taken that nothing very cold (as ice) has recently been in the mouth.

The *Rectum* gives results more accurately and rapidly than either of the preceding, and it is sometimes preferable, especially in the case of children, where axillary measurements are often irksome, tedious, and unsatisfactory. The bulb is oiled and introduced two inches within the bowel, and held steadily till the maximum is reached; this always occurs in two, three, or four minutes. If very young, the child may be placed on his left side, in the nurse's lap, with his face to her right breast. The objections to the rectum (apart from the annoyance and exposure involved) are the possible compression of the bulb by the bowel, the chance of the bulb being inserted into hard feces and so prevented from being in contact with the bowel, and the possibility of its being affected by the descent of fluid feces from a higher and warmer level; in any of these cases the temperature of the rectum itself, which is what we desire, may really be missed. The temperature of the rectum as compared with the axilla may be quoted roughly at three-quarters of a degree Fahr. or nearly one-half degree centigrade higher than that of the axilla.

The *Vagina* yields accurate and rapid results with the thermometer, but is only seldom to be recommended for clinical observations; the temperature in cases of labor, uterine diseases, &c., may sometimes be thus tested with advantage. The *Urine* sometimes affords rapid and useful information, if it be passed into a vessel slightly heated, and if the temperature be immediately taken with a sensitive registering thermometer.

The time of day at which the temperature is taken should be noted, or at least clearly understood. The human temperature has a daily range, during health, of two or three degrees of Fahrenheit's scale (say a degree or a degree and a half centigrade): the range is more marked in children than in older persons: the temperature rises in the early morning hours, attains a maximum in the afternoon, and falls so as to be at its minimum an hour or two after midnight. In fevers, likewise, there is a daily range, the minimum occurs usually some time about 4 A. M.; the daily ascent varies somewhat, beginning usually earlier in the day in severe than in mild cases, but as a rule it is distinctly manifest about mid-day or towards the afternoon: the maximum may be expected, most frequently, about 8 P. M. In hectic fever, and in certain stages of enteric fever, the morning temperature is often nearly normal, although the afternoon and evening readings may be very high. (See Figs. 1 and 6.) Sometimes, however, the type is "inverted," the temperature being low at the hours at which it is usually high. The importance of having the observations made at the same hours, so as to have them comparable with each other, becomes thus very apparent. This likewise shows the danger of relying on one observation (especially in the morning or forenoon) as proving the absence of pyrexia. In some diseases the oscillations follow definite rhythmical courses of

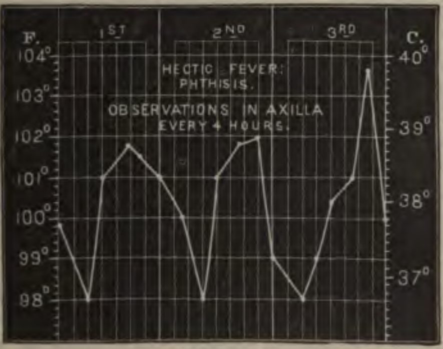

Fig. 1.—Diurnal range of the temperature in Hectic Fever

their own (as in quotidian, tertian (Fig. 5), or quartan intermittents), but in others the daily oscillations are sudden and erratic (as in pyæmia). Frequently repeated observations in the course of the day reveal some curious and important facts in the history of the temperature; in this country, however, only two or three observations in the day are usually taken, so as to avoid fatiguing or annoying the patients. If frequent observations are to be made, the best hours are about 2, 6, and 9 A. M., 12 noon, 3, 6, 9, and 12 P. M.; and special readings should also be made in connection with rigors, convulsions, or other unusual occurrences and also in testing the effect of remedies, or of any special anti-pyretic treatment.

Normal and Abnormal Temperatures may be classified as follows:—[1]

Below	35° Cent.	=	95° Fahr.	Very low, or Collapse Temperatures.
	36° Cent.	=	96.8° Fahr.	
About	36½° Cent.	=	97.7° Fahr.	Subnormal Temperatures.
Normal	**37°** Cent.	=	**98.6°** Fahr.	**Normal Temperature.**
About	37½° Cent.	=	99.5° Fahr.	Slightly above Normal, or Sub-Febrile Temperatures.
	38° Cent.	=	100.4° Fahr.	
	38½° Cent.	=	101.3° Fahr.	
About	39° Cent.	=	102.2° Fahr.	Moderately Febrile Temperatures.
	39½° Cent.	=	103.1° Fahr.	
About	40° Cent.	=	104° Fahr.	Highly Febrile Temperatures.
	40½° Cent.	=	104.9° Fahr.	
Above	41° Cent.	=	105.8° Fahr.	Hyper-pyretic Temperatures.

Such a table enables us, on reading the thermometer, to affirm the absence, the presence, or the degree of pyrexia in a patient at a given time; but this really supplies but little information. The temperature may be normal and yet the patient may be dying or may even be in the midst of a dangerous fever, which will manifest itself in the course of an hour or two as a burning heat. We often, however, detect by the thermometer a degree of pyrexia when we have but little expectation of doing so, judging from the patient's pulse, skin, or general aspect; or when, as in a rigor, or in cholera with coldness of the surface and extremities, an inexperienced person would think a febrile heat impossible. Very high or very low temperatures may also, as a rule, be regarded as evidencing, in themselves, a dangerous condition. Hyper-pyretic temperatures occur as serious complications in rheumatic fever, and some other diseases, associated usually with great cerebral disturbances. Very high temperatures, lasting but a short time just before death, are not uncommon in various diseases. (See Fig. 2.) Very low temperatures, however, are equally or even more common just at the end. (See Fig. 3.) Collapse temperatures, as taken in the axilla, are sometimes due to a surface depression, so that if we wish to know whether the internal heat is really lowered in such cases, we must apply the thermometer to the rectum or vagina. (Compare terminal temperatures in Fig. 7.) The thermometer only supplies information as to pyrexia at the given time; its indications, therefore must be interpreted with due caution, and in view of all the facts of the disease.

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[1] The various degrees are here given in both scales, as the Centigrade is likely to come into more general use.

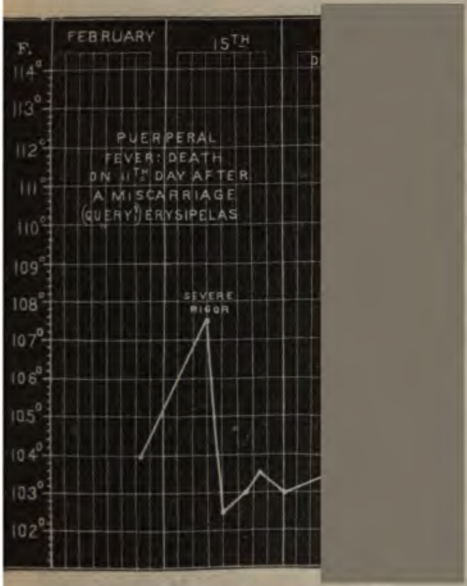

Fig. 2.—Unusually high temperature just before death.

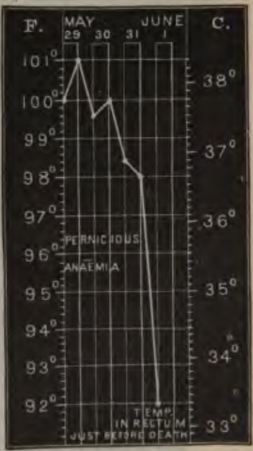

Fig. 3.—Very low temperature just before death.

The manner of rise in the temperature, and the duration of the pyrexia, with regard to the date of the illness, are often most valuable for diagnosis. Some diseases are remarkable for the rapidity with which the temperature rises. Most of the short fevers or febriculæ, as they are called, begin suddenly, and rapidly attain their maximum. (Fig. 5.) Amongt these are the surgical febriculæ (immediately after operations), and the feverish attacks, associated with obscure and often transient disturbances of the general health, due to disorders of the digestive organs, especially in childhood. The following likewise usually show a rapid development of pyrexia: Suppurations, and most of the diseases ushered in with severe rigors, ague, tonsillitis, acute nephritis, scarlatina, smallpox, pneumonia, pleurisy, peritonitis, meningitis of the convexity, relapsing fever, erysipelas, pyæmia, parotitis. All of these may have very high temperatures on the first day of the illness. Occasionally in malignant cases of smallpox and scarlet fever the disease proves fatal so early that the system is overwhelmed with the poison and never shows any febrile heat. Measles sometimes almost reaches its maximum temperature on the first day of the fever, although a marked fall usually intervenes between this and the maximum temperature reached on the fourth or fifth day with the full development of the rash. A great and sudden elevation of the temperature is so common in the diseases named above that they should always be thought of in doubtful cases.

Other diseases are rather characterized by a more gradual and progressive elevation of the temperature; this is especially observed in enteric fever (Fig. 4), although exceptional cases of this disease occur in which the pyrexia attains its maximum at what seems to be the very beginning of the illness. But in enteric fever, as a rule, the elevation is such that during the first three or four days every day marks an advance on the previous one, the morning temperature falling from the elevation of the previous night, but being in excess of that of the previous morning. In typhus fever, the advance of the temperature is somewhat more sudden than

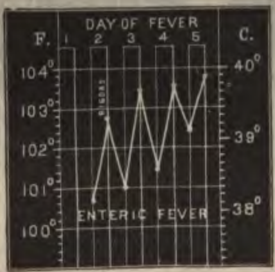

Fig. 4.—Gradual rise of temperature at the beginning of Enteric Fever.

in enteric, but in it, likewise, several days usually elapse before the maximum, or any *very* high point is reached. In articular rheumatism, affecting several joints, in catarrhal pneumonia, in acute tuberculosis, and phthisical affections, the ascent of the temperature is usually spread over several days.

The *duration* of the pyrexia often assists the diagnosis. The complete and continued subsidence of the temperature, within a week, may serve to exclude typhus and enteric fevers; its prolongation for 12 or 14 days, without any febrile rash or any evidence of local inflammatory mischief, may sometimes guide us to the diagnosis of enteric fever; or its persistence may, in a chest complaint, lead us to the diagnosis of phthisis or empyema.

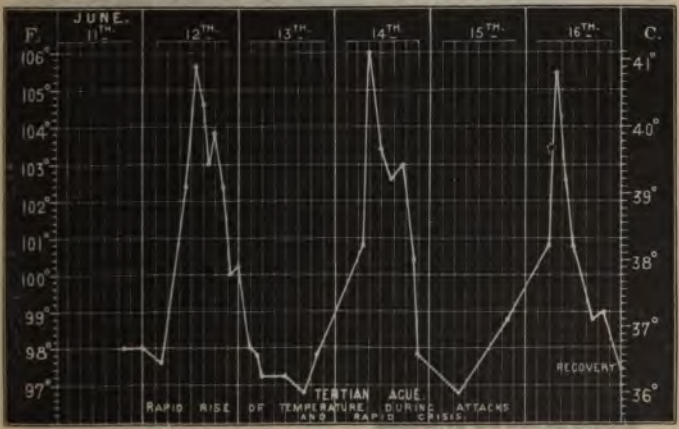

Fig. 5.—Temperature in Tertian Ague.

The decline of the temperature, both as regards its date and manner, is of the utmost importance in prognosis and sometimes in diagnosis. The favorable termination of a febrile disease, by a rapid fall of the temperature to the normal or subnormal level, constitutes a *Crisis*. This fall may amount to 3 or 4 degrees or more in 12 to 36 hours. This method of termination is common in pneumonia (lobar), relapsing fever, typhus, smallpox, tonsillitis, facial erysipelas, and febriculæ of various kinds. It suddenness is represented in the diagram of ague (Fig. 5). It occurs, however, in a modified and less abrupt manner in measles, and sometimes in enteric fever. The suddenness of the crisis varies much in different diseases and even in different cases; in many cases of typhus, a gradual diminution, extending over 3 or 4 days, is sometimes so marked as to make the crisis in this disease much less pronounced than is usually stated, and to assimilate it rather to a lysis.

Lysis is the term applied to a more gradual diminution of the fever, spread over several days; this may usually be observed in scarlatina, broncho-pneumonia, occasionally in pleurisy and pericarditis, and also in acute rheumatism. Sometimes the lysis assumes a remitting character, the morning temperatures falling gradually or suddenly, and the evening temperatures preserving, for some days, nearly their former elevation. This is not uncommon in enteric fever (see Fig. 6).

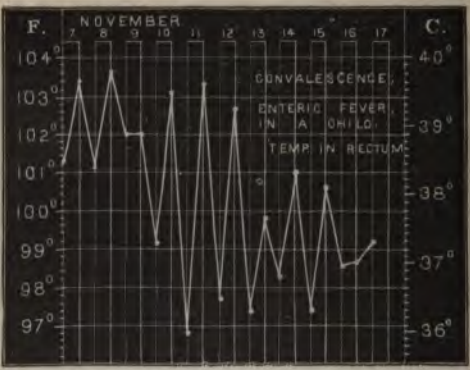

Fig. 6.—Remitting Lysis in Enteric Fever.

Certain fallacies beset the estimation of the value of a fall of temperature. It is very often found that a high febrile temperature undergoes a great diminution on the day after admission to the hospital; this seems often to be really due to an unusual elevation on the day of admission, from the disturbance of moving the patient, etc. Occasionally a *pseudo-crisis*, as it is called, occurs a day or two before the real crisis, the temperature, after being low for a few hours, mounting up again to its former height; this *pseudo-crisis* affords no guarantee of a subsequent genuine crisis. Collapse temperatures may simulate a crisis, although really indicative of serious complications, as in the intestinal hemorrhage of enteric fever, where the cause of the fall may not at first be quite apparent. The fatal termination of some cases of febrile disease is often associated with a marked fall in the temperature (see Figs. 3 and 7). Collapse temperatures may occasionally be detected for a few hours in the midst of a raging fever, or just before the terminal exacerbation of a febrile disease, whether it be favorable or fatal. Sometimes the decline of temperature in a tubercular subject is connected with the supervention of cerebral complications.

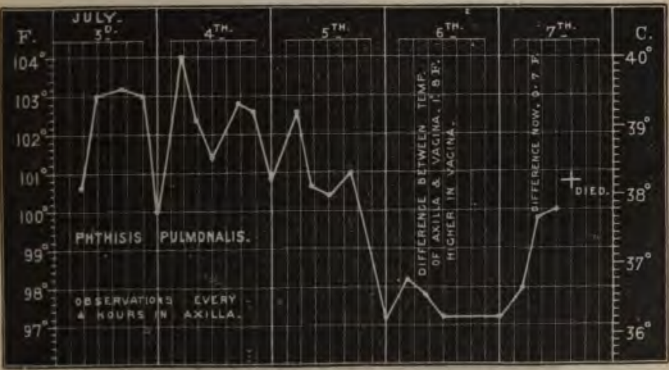

Fig. 7.—Collapse of the temperature simulating an improvement. Comparison of axillary and vaginal measurements of the terminal temperatures.

Complications and Relapses are often marked by a reascent of the temperature, and in such cases the rise is usually sudden. Complications may, by their presence, delay a crisis, as is often seen in bronchitis complicating typhus, and so prolong the illness; or the complication may impress a remitting character on the fever, as is seen in the hectic fever sometimes developed in a case of tubercular pneumonia or pleurisy. The temperature of convalescents, however, it must be remembered, is very unstable, and there is often a serious looking disturbance of the temperature in them from very slight causes (indigestion, constipation, fatigue, excitement, &c.), which would not thus affect the healthy. For this very reason, temperature observations in this stage are highly important, as affording the best evidence of continued safety or the first alarm of threatened danger.

From what has been said, it will be seen that the temperature, although of the utmost importance in diagnosis and prognosis, must not be regarded too exclusively, or apart from the other facts of the case and the general state of the patient. The natural course of the temperature in the various diseases, as ascertained by experience, must be kept in mind; an elevation or a special behavior of the temperature may have a very serious significance in one disease and very little in another. The comparison of the temperature with the pulse often serves to correct our views of each, and although they usually rise and fall together, certain deviations occasionally or habitually occur in special diseases, or in certain stages of such affections, which are of the greatest significance. (For example in the beginning and the end of enteric fever, and towards the end of tubercular meningitis; see Pulse, p. 79.)

THE PULSE

affords such valuable indications for the determination of the febrile state, and for estimating the general strength of the patient, that the noting of it is a matter of routine in all cases. Apart from fever, however, there are other important points to be attended to in noting the pulse, and to prevent repetition these also will be considered here.

The frequency of the pulse is not difficult to estimate; the pulsations in the artery, the radial by preference, are counted for a quarter or half a minute, with the aid of a watch furnished with a seconds dial, and the number per minute is thus calculated. For delicate inquiries, the pulse should be counted for a whole minute, or even for two consecutive minutes, the number being halved of course in stating the result. Other points also must be attended to when accuracy is desired. The normal rate of the pulse varies with age, and also in different individuals (according to temperament); in the adult it is usually stated as being about 72, but it is sometimes higher and often much lower: it is more rapid in childhood, and in infancy is often about 100, apart from disease. In the same individual the pulse varies with position, both in health and disease, the rate being higher when the patient is standing than sitting, and higher while sitting than lying down: any movement or exertion tends to increase the rate, and mental excitement is particularly apt in some people to make it rise very high. Hence in estimating the pulse or its changes from day to day, in such a delicate inquiry, for example, as the estimation of an incipient defervescence, care must be taken to have results really comparable, and not to compare the rate of the pulse while the patient is sitting up in bed with that obtained on a previous day while he was lying still. The influence of meals is also very great, the pulse rising considerably after a full meal, and especially after the use of stimulants in the healthy state; in febrile diseases, however, the effect of stimulants is often to reduce the pulse-rate when their influence is beneficial. The time of day has a certain influence in the normal state, even apart from food and exercise; the pulse-rate is lower during the midnight hours, and rises in the early morning, but the exact time of these changes varies; they are usually later if occurring in febrile diseases than in the normal state. Sleep has a tendency to reduce the pulse-rate. Considerable tact is often required to secure a fair estimate of the pulse; in some cases we obtain the best chance at the beginning of our visit, counting the pulse before the patient is disturbed in any way by speaking or moving; or perhaps, especially if he be a child, while he is still asleep. With some patients again, the approach of any stranger sets up the pulse to such a height that we must wait till it has subsided. The lowest rate we can obtain is the most reliable index of the degree of fever. A fit of coughing, or the exertion of moving or sitting up for the purpose of auscultation, &c., often completely spoils the value of the pulse-rate as a gauge of pyrexia. It is in such cases that temperature observations come in as a valuable check (see Temperature), and these often assure us that the rapidity of the pulse is due to excitement, general weakness, or irritability of the heart, apart from fever. As a rule, the pulse and temperature in febrile cases are elevated or depressed, and rise and fall together; but striking differences occur in certain cases. The pulse is often but little elevated in the beginning of enteric fever, at a time when the temperature is very high; while after the recovery has begun, the pulse may be rapid from weakness, although the fever temperature has completely fallen. In cerebral cases, also, the relationship of the pulse-rate to the temperature is subject to special variations; the terminal stage of tubercular meningitis is often characterized by a high pulse and a comparatively low temperature. The ratio of the pulse-rate to the frequency of the respiration, is sometimes of value as an index of the existence or supervention of respiratory disease. (See Respiration, Chapter ix.)

The force or strength of the pulse often guides our prognosis, and directs us in the treatment, especially as regards stimulants. It is not easily estimated by the beginner; it requires experience and the watching of cases (especially febrile cases), from day to day, for the education of the fingers. Sometimes the radial pulse gives a fallacious idea of weakness, from the vessel being of unusually small size (high division or other abnormality). Pressure on the arm from the patient's position in lying on it may also interfere with the radial pulse. Moreover, the radial arteries on the two sides are often of very different size, and so we find that errors sometimes arise from detecting a difference due merely to an accidental change in the observation—the different arm being taken instead of the one usually felt. In doubtful cases the radial or other arteries on both sides should be examined, and the heart's sounds should be listened to. When the pulse is really very weak, the first sound of the heart is usually diminished and sometimes almost suppressed, the second sound remaining distinct. Differences in the strength of the two radial or other pulses are often of value in diagnosis, particularly in cases of aneurism of the arch of the aorta, giving rise to more or less obstruction of certain branches. Sometimes the two pulses are not perfectly synchronous from similar causes. Occasionally, also, the diminution and obliteration of an arterial pulse serves to indicate the occurrence of embolism, but care must be taken to see that these differences are not due to unusual distribution of the vessels. A survey of the arteries should be made, both with the finger and eye, when judging of the force of the pulse, and the examination should not be limited merely to the part of the radial artery at the wrist; by extending our observation we may detect any undue rigidity, twisting, or unevenness of the vessels. Sometimes other arteries must be examined to satisfy ourselves on this subject; the temporals and the branches of the thyroid axis are selected for the purpose of testing the smaller vessels, the brachials and the femorals as a sample of the larger.

The rhythm of the pulse is in health perfectly regular, so that any deviation from this should be noted. Sometimes there is a distinct intermission, a loss of a beat at regular or irregular periods, but there may be such a loss in the radial pulse without any corresponding intermission in the heart's sounds or action; there may thus be a marked difference in the pulse-rate as counted at the wrist and at the heart. Or the irregularity may consist of two or three hurried beats followed by a succession of slower ones, or in the occasional occurrence of one or two weak or almost suppressed beats. Sometimes the pulse varies greatly in strength throughout a given minute, without any intermission or marked change in the rhythm. This change in the strength of the pulse in certain cases can be made out to be associated with the respiratory movements, or with the occurrence of convulsions, or some other visible phenomena. The significance of irregularity of the pulse is most varied. It sometimes affords one of the first indications of brain mischief, especially in children, or of incipient pericarditis. It is very common in various forms of heart-disease, at all ages, especially in mitral disease, fatty heart, and the degenerations incident to old age. (See Fig. 16, p. 85.) Apart from these, however, it is often due to functional disturbances, especially such as are associated with indigestion, flatulence, &c. A more serious form of disturbance leads to the intermission found in typhus, and other fevers. It is likewise developed, not unfrequently, through nervous agitation, in certain persons, just as acceleration of the heart's action or fluttering is produced in others from the same cause; concentration of the attention on the intermission is apt in such cases to increase the irregularity. Some persons, apart from any medical knowledge, have an obscure sensation of the intermission, which causes a start or a shock. In states of debility, during convalescence from serious diseases, and in the case of children after enteric fever, for example, intermission of the pulse is sometimes associated with unusual slowness, and is specially noticeable at night. This does not imply any real danger.

Dicrotous Pulse.—Somewhat allied to the rhythm is the curious double beat in the pulse, sometimes felt in febrile cases. It is not uncommon in the convalescence from typhus fever. This is best felt by applying the pulp of the fingers very lightly over the vessel, avoiding any such pressure as would extinguish the weak second beat. The sphygmograph brings out this dicrotism very clearly. A little practice with this instrument is useful in educating the fingers in the recognition of dicrotism. (See Sphygmograph—Fig. 10.)

The pulse of unfilled arteries, characterized by a sudden filling up of the artery, followed by a very sudden collapse of the vessel under the finger, often enables us to suspect, or sometimes even to diagnose, incompetency of the aortic valves, on feeling a patient's pulse. The peculiarity is brought out in a more striking way by raising the patient's arm vertically while feeling the radial pulse; visible pulsation throughout the arteries in such cases is usually very marked. The sphygmograph gives a very striking and characteristic rendering of this pulse. (See Sphygmograph —Fig. 12.)

A thrill in the pulse can often be felt in certain cases of cardiac disease (mitral and aortic valvular disease), and this also is sometimes rendered very plainly in the sphygmographic tracing.

THE SPHYGMOGRAPH

is an instrument designed to enable the pulse to register itself, and so affords a permanent record of *its frequency, its force, and above all of the characters of the pulse wave.*

The essential parts of the instrument are a spring which rests upon the artery and has its movements communicated to it; and a lever which amplifies these movements and records them on a strip of paper carried along by clockwork. Marey's instrument, with slight modifications, is the one usually employed, and as it can be seen in all well appointed hospitals, no detailed account of its mechanism need be given. The sphygmograph to be used, however, should have Mahomed's modification for estimating pressure. The artery for which it is specially adapted is the radial, and the point at which it is most advantageously applied is just where the artery crosses the styloid process of the radius. The advantages are, that the vessel is here very superficial and supported on a flat firm surface. If possible the patient should be in the recumbent posture, as this generally assures the most tranquil state of the circulation, and great care should be taken that the humeral artery is subject to no pressure in any part of its course. The instrument may also be applied while the patient is in the sitting posture, his arm resting on a table in front of him. We search carefully for the exact site of the radial artery, and having found it mark its position with ink. We lay the wrist into the cushion devised by Anstie to keep the hand steady, with the knuckles touching the table or bed, and having placed the button, which the spring carries at its free extremity, immediately over the artery, we buckle the instrument to the cushion by means of a band of elastic braid. If the spring is not accurately adjusted over the artery, we may shift it about a little without undoing the instrument, but generally it is preferable to apply the sphygmograph afresh. After the spring is adjusted, we connect it with the lever, and see that it is working properly, before any attempt is made to register the tracing on paper. Great care must be taken that the spring is fairly saddled on the artery, the least deviation to the side deforming the tracing. The pressure must also be very nicely regulated. A number of tracings with varying degrees of pressure should be taken at a time and the most perfect selected. The slips on which the tracings are to be taken may be prepared in several ways; a very easy method is to blacken the paper in the smoke of a turpentine flame from a paraffin lamp—foreign note paper answers the purpose very well—and when the tracings are taken, the patient's name and the date, with the pressure employed, may be written on them with a needle or other sharp point, and they are then varnished by dipping them in a solution of shellac in rectified spirits. In Marey's instrument, the tracings may be written with pen and ink, but the above method gives more delicate results. Smoked glass may also be used instead of paper.

The following are the names applied to the various parts of a pulse tracing:—

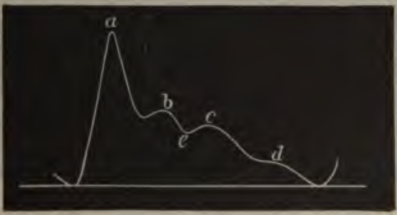

Fig. 8.

a Primary or Percussion Wave, *b* Secondary or Tidal Wave, *e* Aortic Notch, *c* Dicrotic Wave, *d* Fourth Wave.

All these parts are represented in a healthy pulse tracing; the pressure used for healthy pulses varies from 1½ to 3 oz.

In the *Febrile or Dicrotic pulse* the tidal wave is lost, the aortic notch lowered and deepened, and the dicrotic wave increased. The pressure employed is as a rule less than in the healthy pulse.

When the aortic notch falls very low, reaching below the level at which the upstroke begins, the pulse is said to be *Hyper-dicrotous.*

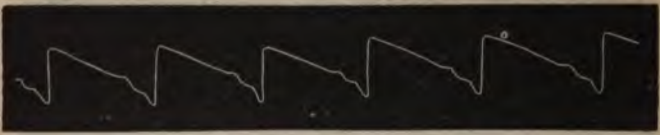

Fig. 9.—*Healthy pulse.* Pressure 3 oz. Pulse 68.

The *pulse of Aortic Regurgitation* is large, the upstroke quite vertical, the apex pointed and well produced, the tidal wave as a rule well marked, the aortic notch low, and the dicrotic wave small.

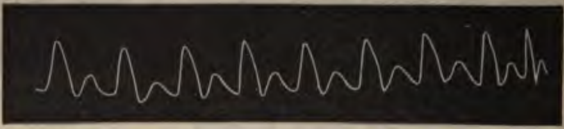

Fig. 10.—*Febrile or Dicrotic pulse.* Pressure 1¾ oz. Pulse 112.

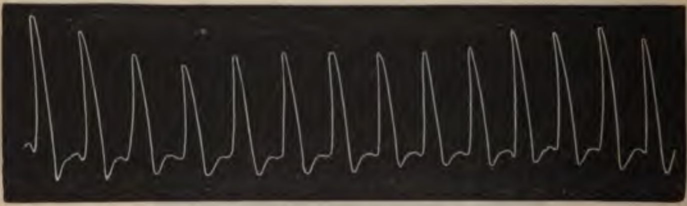

Fig 11.—*Hyper-dicrotous pulse.* Pressure 2 oz. Pulse 120.

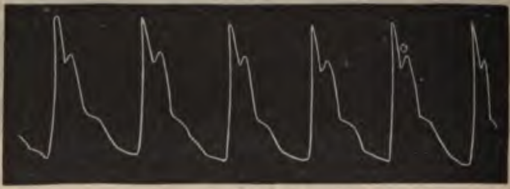

Fig. 12.—*Pulse of Aortic Regurgitation.* Pressure 2¾ oz.

The following pulses from a case of thoracic aneurism show a marked *difference on the two sides.*

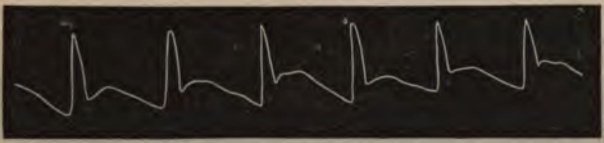

Fig. 13.—*Right Radial.*

The Senile Pulse or Pulse of Rigid Arteries.—Its most marked features are the substitution of a plateau for an apex, and the unbroken character of the descent line.

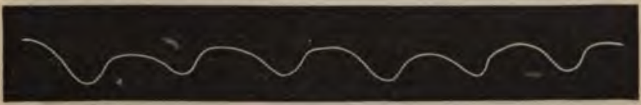

Fig. 14.—*Left Radial.*

In Bright's disease, especially of the chronic type, the tension in the arterial system is usually much increased.

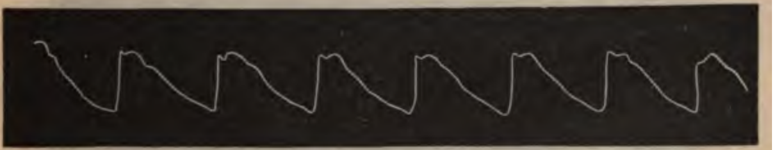

Fig. 15.—*Senile Pulse.*

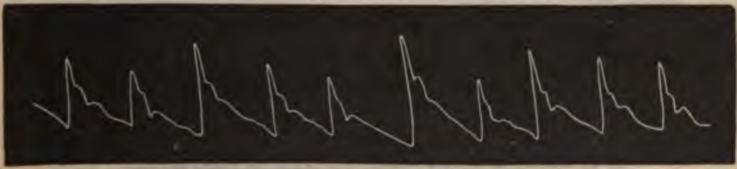

Fig. 16.—*Tracing from a case of mitral regurgitation, showing the pulse irregular in force and rhythm.*

This is indicated by the marked tidal wave, by the small dicrotic wave occurring high up in the diastolic part of the tracing, and by the great pressure which the pulse will bear. The following tracing from a patient, 10 years of age, illustrates these characters.

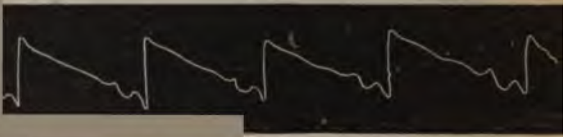

Fig. 17.—*Pulse tracing from a subacute case of Bright's disease.* Pulse 56. Pressure 5 oz.

GENERAL OR CONSTITUTIONAL INDICATIONS OF THE FEBRILE STATE.

In addition to an increased temperature and a rapid pulse, there are certain general signs of fever which are of great value. *Flushing of the face* is common in fever, but care is required to prevent mistakes in judging of this, as the color of the cheeks varies much in different persons, and such an accident as lying on the cheek often produces a local flush, apart from fever; in such cases the thermometer is an invaluable guide. *Sweating* is habitual in some fevers (enteric and rheumatic fevers), and is common in certain stages of most febrile diseases; the total absence of sweat, giving the sense of a dry pungent heat to the hand as applied to the skin, is an important fact. The sweating is sometimes habitual, as in the night or early morning sweatings of phthisis; it is also often cold and clammy, and in such cases it may be associated with bad dreams; this combination is common in cases of deep-seated suppurations, disease of the bones, &c. Sweating is sometimes local, as of the head in rickets; or of one side of the body, in certain affections of the sympathetic nerve, sometimes apart from any other obvious disease, and sometimes connected with aneurismal or other tumors in the chest or neck. *Headache and pain in the back* are very common in nearly all the acute specific fevers at their beginning, and one or other is usually present, more or less, in all febrile states. Pain in the back is very specially pronounced in cases of smallpox. (Of course these pains are often due to quite different causes, see Chapter vi.)

Unequal distribution of heat, a feeling of heat in the head and cold in the extremities, a burning heat in the hands or the feet, a sense of cold water trickling down the back, a feeling of chilliness increased on any exposure to a draught of cold air, and actual shiverings in all degrees of their severity are exceedingly common in the beginning of febrile diseases, especially before the patient has taken to bed; these sensations often lead him to hang about the fire-place, complaining of cold, although his temperature may be very high; they tend to disappear when, by proper heating and clothing in bed, the temperature of the various parts of the body becomes more equalized. While shiverings are common at the beginning of all inflammatory and febrile diseases, they are especially frequent and repeated in ague, in serious suppurations, in renal inflammation and renal colic, in cases of gallstones, and in embolism and pyæmia. Young children seldom have distinct shiverings. Rigors also occur occasionally in connection with sudden defervescence. Many of the sensations just referred to, and even actual shiverings, occur apart from fever altogether in nervous subjects; the thermometer is here, again, invaluable. *The digestive functions* are almost always impaired in febrile diseases, and especially at the onset of the specific fevers. Vomiting is very common in the last named, and is sometimes very severe and persistent (smallpox, scarlatina, and occasionally enteric fever); in other cases slight sickness or nausea is all that is complained of. The appetite is almost always impaired, and often completely depressed. The bowels are usually disordered; the febrile state tends, as a rule, to produce constipation, but occasionally diarrhœa is seen to result from the action of the specific fever (as in the beginning of malignant scarlatina), and sometimes there is a special connection between the diarrhœa and the febrile disease (as in ulceration of the bowels in enteric fever, and in tubercular and dysenteric ulcerations); at times, however, the looseness of the bowels seems related to the pyrexia, as such and ceases with it. The state of the tongue reflects the constitutional disturbance produced by the fever so far as the digestive organs are concerned. (See Tongue, Chapter xi.) Thirst is almost always present in the febrile state, especially at the beginning of the illness, and, notwithstanding the large amount of fluid swallowed, the urine is usually scanty and high-colored. *Muscular prostration* is present in all severe cases of fever, and is often very marked even at the beginning of some of the specific fevers. *Delirium* is usually associated, in very varying degrees however, with high ranges of pyrexia from whatever cause; the degree of it, and the date at which it appears, as well as its character, vary much in different diseases. *Convulsions* sometimes take the place, as it were, of delirium, especially in young children, and often mark the beginning of acute inflammatory or febrile diseases in them. A degree of *bronchial catarrh* is not uncommon in nearly all serious febrile states, and is a special feature in some. *Cutaneous eruptions* are characteristic of certain febrile diseases. (See Febrile Rashes, p. 105.)

THE CLINICAL SIGNIFICANCE OF THE FEBRILE STATE is very great, and this remark applies both to the presence and absence of this state in a given case. It has already been explained how the febrile state is to be judged of; the possibility of our observation occurring in an apyretic interval must be remembered before we arrive at a negative conclusion. Sometimes the fact of fever (*i. e.*, pyrexia) is all that can be made out; but without denying the existence of a simple continued fever, we are seldom justified in resting satisfied till we either have referred the pyrexia to one of the specific fevers (typhus, scarlatina, ague, pertussis, &c.), or have ascertained that it is symptomatic of some special inflammation (pneumonia, pleurisy, abscess, rheumatism, &c.), or at least of some disease known to be associated with febrile disturbance (phthisis, tuberculosis, syphilis, &c.).

(1.) *Specific Fevers and Rashes.*—In determining this question, attention must be directed to the presence or absence of the "rashes" found in most of the specific fevers (see p. 105). These must be carefully searched for in their favorite situations, and the date of the illness must be considered in this respect, as to whether there has been time for the appearance of the rash. As the exact date of the illness is often obscure, and as the day on which a febrile rash appears deviates occasionally from the average times usually stated, some little allowance must often be made for such variations before arriving at a decision. The occasional absence of the rash, in nearly every fever usually characterized by an eruption, must also be remembered. Other circumstances often render the existence of such fevers very probable, or indeed certain, even when no rash has appeared. In examining for a febrile rash, other cutaneous eruptions (not of this class) may be detected, and it must be considered whether the eruption discovered is of the kind and of the extent to account for, or to be in harmony with, the febrile movement. Some skin diseases, as they are called, are associated with much fever, others with little or none. The possibility of an eruption from the use of medicines, and the influence of certain articles of diet must be kept in view. (See Eruptions from Medicine and Food. p. 101.) Moreover, when there is high pyrexia, a certain congestion of the skin, especially in dependent parts, sometimes simulates a scarlet rash. Eruptions indicative so far of certain diseases, although they cannot be called specific, are sometimes found in the febrile state—such as herpes labialis in pneumonia, or miliary vesicles in enteric and childbed fever, rheumatism, &c. Occasionally a rash is found in diseases not usually characterized in this way; thus we may have a rash in diphtheria and relapsing fever, and in the early or pre-eruptive stage of smallpox and enteric fever.

(2.) *Inflammations.*—When no specific rash exists, and no distinct history of contagion is suggested, search must be made for signs of inflammation, and although the case may be admitted to a medical ward, the possibility of superficial inflammations or abscesses, periostitis, otitis, parotitis, and other glandular inflammations, must never be forgotten, especially in the case of children or those unable to express their sensations. Tonsillitis, quinsey, pharyngeal abscess, scarlatina, and diphtheritic sore throat must also be remembered in this connection. Pain and its situation usually guide us to these and similar inflammations, and also to articular or muscular rheumatism. Regarding internal inflammations, the importance of examining the chest cannot be overrated, as we often find there the explanation of the febrile disturbance. This must never be neglected. Inflammations of other internal organs usually indicate their existence by pain over the parts, or by changes in the excretions, or by other alterations in the functions, such as paralysis, delirium, &c. A systematic search must be made into the state of all the important organs before arriving at a negative conclusion.

Shiverings are common in various febrile diseases, especially at the beginning; but when severe and recurring, the idea of suppuration somewhere is suggested, or perhaps embolism and pyæmia. Such suppurations may be in parts beyond the reach of our diagnosis, but search must be made for tender regions in the principal organs, and also in the joints.

(3.) Care must be taken not to conclude at once that the febrile state is due solely or chiefly to the inflammation which we may have detected by our examination. For example, bronchitis is an habitual accompaniment of typhus, and pneumonia is common in many fevers. Inflammation or congestion of the kidneys (with albuminuria) is a frequent complication in many complaints. It is often difficult to know whether we have to do with a primary, a secondary, or a mere coincident inflammation; the date of the illness, and the known characters of the disease, often assist us, and the want of correspondence between the apparently slight extent or severity of the inflammation and the intensity of the fever, sometimes leads us to suspect that there is something behind the local inflammation.

CHAPTER IV.

SKIN—HAIR—NAILS—GLANDS—JOINTS.[1]

CUTANEOUS ERUPTIONS.

ERUPTIONS on the skin are sometimes brought prominently under our notice as the chief part of the patient's complaint, or at least are so obvious that they cannot be overlooked; but in other cases we have to search carefully for an eruption which the patient may be unconscious of, or which he may regard as quite trivial and accidental. Most of the cutaneous eruptions serve to indicate the presence of some constitutional affection or general tendency. Thus the eruptive fevers present on the skin the evidence of a general disturbance of the whole system. The occurrence of early late syphilitic eruptions likewise reveals a constitutional affection, and the same may be said of scrofulous and perhaps of cancerous diseases of the skin. The pigmentations of pregnancy and Addison's disease, the blotches in scurvy and purpura, and the influence of certain medicines in producing eruptions of various kinds all indicate the same thing. Eczema and psoriasis, from their symmetrical distribution, their tendency to recur, and their association with certain other diseases in the patient himself or in his family, can often be shown to be much more than mere local diseases. Even parasitic affections of the skin often owe their rapid development and persistency to the general state of the health; the vegetable parasites do not seem to find a suitable nidus in perfectly healthy subjects.

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[1] In addition to the works on general medicine and diseases of children, we must also refer to surgical treatises regarding certain cutaneous and glandular affections.

For the Febrile Eruptions, see especially Reynolds's System, Vol. I., and Murchison on Continued Fevers (with colored illustrations of Typhus and Enteric Rashes).

For Skin Diseases, consult the works of Tilbury Fox, M'Call Anderson, Neumann, and Hebra. For illustrations of these, see the Atlases by Tilbury Fox and Erasmus Wilson. The plates issued by the New Sydenham Society are perhaps the most accessible. See also Greenhow on Addison's Disease.

Regarding Affections of the Joints, the reader may refer to the articles on gout and rheumatism in various medical treatises, and especially in Reynolds's System, Vol. I.; surgical works may also be referred to with much advantage, especially Holmes's System, Vol. IV.

These remarks are designed to direct attention to the two great points in the study of cutaneous eruptions—the local condition and the general state. The general derangement may manifest itself by changes of which the skin affection is but one out of many; or the cutaneous disease may be the sole manifestation, or at least the chief evidence, of the general disorder. On the other hand, affections of the skin arising purely from local causes, or, as more frequently happens, aggravated by local influences, may produce a general disturbance of the whole system.

For the classification of skin eruptions the most satisfactory and the most solid system would be one based on their causation, rather than on their special forms. Hitherto this has only been possible to a slight extent, as the causes of many eruptions are unknown, and the causes of others are not uniform, or perhaps are complex and indirect. The real cause of eruptions must be kept in view, however, so far as this is possible. It is of the utmost importance, for example, to know whether an eruption is due to iodide of potassium, to smallpox, to syphilis, or to scabies: any system which would group together such diverse affections as "papular" or "pustular," even although they may all present papules or pustules, tends only to mislead. And further, any grouping of skin eruptions based merely on the elementary lesions is rendered impossible for any useful purpose, when we find scabies, for example, presenting at different times, or even in different parts at the same time, such diverse lesions as papules, vesicles, and pustules; or when we find eczema at one time papular, at another vesicular, at another pustular, and at another somewhat scaly; or when we find syphilis assuming every variety of form.

Still, as the causes of eruptions are often unknown, and cannot even be suspected by the inexperienced, we avail ourselves of the obvious distinctions afforded by the peculiarities of the lesion; and when nothing more can be done, the student may at least describe the nature of the lesion, the extent and distribution of the eruption, and the genera and local symptoms associated with it.

THE ELEMENTARY LESIONS, indeed, formed the basis on which Willan and Bateman's classification was built; and, although now discarded, like most of the old nosological systems, the facts on which it rested are of great value and are still constantly referred to.

Erythema[1] is a simple redness of the skin, fading readily on pressure, and not extending to the cellular tissue. (Erythema may be simply symptomatic of adjacent inflammation. Among the varieties of erythema we have, E. læve, E. intertrigo, E. nodosum, E. fugax, and E. gangrænosum.)

Wheals[1] (pomphi) are well represented by the red and white elevated patches produced by the sting of a nettle, or the bite of a bug, or even of a flea; in slight forms the white portions may not appear; in severer forms they may be complicated with blisters. (Wheals occur in urticaria in its acute and chronic forms. "Factitious urticaria" is the name used for the variety produced in certain persons by mechanical irritation.)

Papulæ are pimples of various sizes and forms; they may, however, be very different in their constitution. (Willan and Bateman included under this heading, strophulus, lichen, and prurigo; but different views now prevail.)[2]

Vesiculæ and Bullæ differ from each other in size, the former being small blisters and the latter large ones. They may be simple, or they may be divided so as to be compound. They may present perfectly clear fluid, or they may contain inflammatory products to a variable extent, so as to present all degrees of turbidity—the separate vesicles passing through these various stages; they may be associated with all degrees of redness of the adjacent skin, or they may be free from this complication. Several may coalesce forming large blisters or "blebs." (Under "vesiculæ," Willan and Bateman included varicella, vaccinia, herpes, rupia, miliaria, eczema, and aphtha; under "bullæ," erysipelas, pemphigus, pompholyx.)[1]

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[1] Willan and Bateman had an order named "exanthemata" which included two of the febrile eruptions (rubeola and scarlatina), and also roseola, urticaria, purpura and erythema. Roseola is now usually regarded as an erythema of a rose color. The name "Erythema," as a special disease, was formerly applied to cases of the slighter forms of erysipelas.

[2] Strophulus and lichen are regarded by many as identical; but strophulus is a vague name, including various different eruptions: it is not always papular, and seems rather to be connected with the sudoriparous apparatus. When not papular, it is to be classed with the erythemata; when papular it need not be separated from lichen. This disease again is regarded by many as a form of eczema (E. papulosum or E. lichenoides.) Pruriginous eruptions are papular; but the enlarged papillæ are often irritated and abraded by scratching. "Prurigo," in this sense, is a valuable indication of itching, as in scabies, phtheiriasis, and urticaria. Prurigo, apart from this, as described by Hebra, is rare in this country.

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[1] Vesicles pass readily into pustules, so that some diseases might be classed under either or both orders. For varicella, miliaria, and erysipelas, see special sections pp. 109, 113, 114. (Aphthæ are little blisters on the mucous membrane of the mouth. See Tongue, Chapter xi.)

Herpes consists of an eruption of small vesicles arranged in groups on an inflamed base: these run their course, and are not usually succeeded by fresh groups of vesicles: there is generally a feeling of tension and burning; occasionally neuralgic pains precede or follow the eruption. "Herpes labialis" is common in ordinary colds: it also appears in many cases of pneumonia, and in some forms of urinary irritation and disease. "Herpes præputialis" appears on the prepuce. "Herpes zoster" (shingles, zona) usually girdles the trunk unilaterally, limited pretty strictly by the middle line, both before and behind, but it may affect the thigh, the face, or an arm, following very accurately the course of certain nerves. It is not infectious, and rarely occurs a second time in a patient.

Eczema is now generally made to include several forms of skin disease which were formerly separated from each other. It is an inflammatory disease with exudation and infiltration of the skin, associated with a sense of burning or itching, and it tends to the formation of crusts. In the ordinary form there are vesicles (eczema vesiculosum) which exude a clear fluid, which has the property of stiffening linen; an excoriated red, and inflamed surface usually remains exposed; the discharge may dry very rapidly into thin crusts resembling scales. In some cases the moist discharge may almost have escaped attention, redness and scaliness of the skin being the chief features (eczema erythematosum and eczema squamosum). In other cases the plastic exudation may remain below the surface, giving rise to little papules—the lichen of older authors, but termed eczema papulosum or lichenoides by some. Or the exudation, either from obvious irritation, or apart from this, may become purulent, and the secretion of pus may be abundant from the beginning: this, which was formerly called impetigo, is now often named "eczema pustulosum," or "eczema impetiginodes." Eczema is named from the parts affected, as "E. aurium," &c.; also from obvious secondary changes "E. fissum," or from the cause, as "E. intertrigo" from friction.

Rupia, see "ecthyma," note, p. 95—(although it may begin as a vesicle with clear fluid, the contents soon become bloody or purulent).

Pemphigus is characterized by large blisters, or bullæ, varying from the size of a pea to that of an egg, with different degrees of inflammation at their base. Occasionally large thin crusts or scales are formed ("P. foliaceus").

Pompholyx is now merely a synonym for pemphigus.

Pustulæ may result from the fluid in the vesicles becoming purulent—this may arise from irritation or other inflammatory action; the pus is often formed so rapidly that it may seem to exist from the beginning. (Willan and Bateman included under "pustulæ," impetigo, porrigo, ecthyma, variola, scabies.)[1]

Squamæ or Scales and Pityriasis.—Scales must be distinguished from thin crusts resulting from dried secretion. Squamæ are scales from the beginning. When the desquamation is very minute the term pityriasis is used. Unfortunately, however, a disease of rare occurrence, "pityriasis rubra" is characterized by the shedding of large scales or flakes. (Willan and Bateman included under "squamæ," lepra. psoriasis, pityriasis, ichthyosis.)[2]

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[1] *Impetigo* is more suitably regarded as a variety of eczema ("E. pustulosum" or "E. impetiginodes"). For *variola* see p. 108. *Porrigo* is either an eczema or, it may be, a parasitic disease of the head (see p. 103).

Scabies is arbitrarily classed under pustulæ; it is, however, quite as much a papular or vesicular disease; it is parasitic, due to the presence of the "acarus scabiei," which can often be picked out as a minute speck with a needle from the end of the narrow furrow found between the fingers and elsewhere. The microscope is required for the examination of this insect; but the furrows can usually be recognized. (See p. 98, Fig. 18.)

Ecthyma is the name given when large pustules exist on the skin. It is often, if not always, merely due to scabies or to syphilis. Syphilitic pustules when large sometimes dry up into dark crusts, shaped like limpet shells: such an eruption is termed "rupia."

[2] *Pityriasis*, or desquamation, occurs after erythema, febrile rashes, and other affections of the skin, so that it often forms only a stage in a disease. "Pityriasis versicolor" is parasitic, and is not properly a squamous disease (see Fig. 22, p. 116). "Pityriasis rubra acuta" is a rare disease characterized by great redness of the skin and the shedding of large true scales, without moisture and without much infiltration of the skin.

Psoriasis and lepra (alphos) are now classed as one disease; the name "lepra" was formerly applied to the patches of this eruption, in which it spread at the circumference (psoriasis circinata) while the centre was free; the form of a ring was thus assumed. This is a true scaly disease, without moist secretions, the scales are white and often glittering, somewhat imbricated and very adherent; they appear on dusky red patches, which are slightly elevated; all degrees of density in the arrangement of scales are found. All parts of the body may be affected; the elbows and knees seldom escape in an abundant eruption of simple psoriasis. When it appears on the palms of the hands, or on the soles of the feet alone, it is almost invariably syphilitic. A form of psoriasis, resembling the shape of rupia crusts, has been named "P. rupioides."

Ichthyosis.—When the skin is dry, harsh and wrinkled, with thin

Tubercula are little lumps, too large to be classed as pimples or differing from them in other respects. They have only an etymological connection with the tubercles recognized in the pathology of internal affections. They include various cutaneous and mucous growths of perfectly dissimilar kind.[1]

(The various diseases formerly classed under this heading are now regarded quite differently. They were: phyma (boil), verruca (wart), molluscum, vitiligo, acne, sycosis, lupus, elephantiasis, frambœsia.)

Maculæ or Stains of the skin are sometimes hemorrhagic; or they may be parasitic; chemical agents and various constitutional disorders produce pigmentary deposits. (See p. 115.)

SECONDARY CHANGES may be present along with various forms of elementary lesion.

Desquamation, although often occurring independently (see "Squamæ") may form the terminal stage of an erythema, or the like.

Crusting is one of the most important secondary changes. Very thin crusts may resemble scales, but careful examination usually shows them to be largely composed of dried secretions (in ichthyosis, however, the scales are epithelial). The discharge may be very slight, and may proceed from a surface not ulcerated, or it may proceed from an ulcer. When the crusts are dark, this usually points to the presence of a sanious fluid retained in them, and this occurs frequently in syphilis. Lupus and syphilis differ in their tendency to scabbing—the ulcers in the former usually scabbing slightly, those of the latter often scabbing freely.

Cockle-shaped crusts are almost diagnostic of syphilis (rupia). Cup-shaped crusts occur chiefly in the head, composed of the parasitic growth termed favus; they are light yellow in color, and rather brittle. (See p. 103.)

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scales loose at their edges, the term "xeroderma" is sometimes used. When the scales are thicker, more abundant, and mingled with sebaceous matter, the name "ichthyosis" is applied.

[1] *Acne*, pimples, often becoming pustules.

Sycoses (see Ringworm of Beard, pp. 101 and 103).

Lupus is an inflammation and ulceration of the skin, occurring in scrofulous subjects, and characterized by the presence of a new formation. When slight and superficial without ulceration, it is called "lupus erythematodes." When the deposit forms little swellings without ulceration, "lupus non-exedens" is the term. When ulcerations and cicatrices are present it is called "lupus exegens."

Ulcerations are secondary changes which must be examined and described in reference to their edges, &c., and any attendant cachexia, as in surgical practice.

Excoriations, fissures, scars, and atrophic lesions are frequently very suggestive, and must be recorded.

The following indicates an attempt at a scientific classification of skin diseases, so far as this is yet possible. (Dr. A. B. Buchanan slightly modified by Dr. McCall Anderson):—

A. *Functional Affections*:—
  Pruritus, seborrhœa, comedones, milium, hyperidrosis, ephelis, melanopathia, vitiligo, atrophia cutis, alopecia, hirsuties, fragilitas crinium.

B. *Organic Affections*:—
  I. Diseases defined by uniform causes:—
    (1) Parasitic affections—*Vegetable*—Tinea favosa, tinea tricophytina (circinata, tonsurans, sycosis), tinea versicolor, tinea decalvans. *Animal*—Scabies, phtheiriasis.
    (2) Syphilitic affections:—Primary, secondary, and tertiary accidents. Hereditary syphilis infantile and non-infantile.
    (3) Strumous Affections:—Lupus, scrofuloderma, lichen scrofulosorum, strumous glands, ulcers, and abscesses.
    (4) Eruptive fevers, Morbilli, scarlatina, varicella, variola, typhus, &c.
  II. Diseases NOT defined by uniform causes:—
    (1) Inflammations:—Erythema (strophulus, pityriasis, rosela), erythema nodosum, eczema (lichenous, pruriginous, and impetiginous), impetigo contagiosa, ecthyma and non-syphilitic rupia, prurigo, urticaria, zona, dermatitis, erysipelas, acne, psoriasis (or lepra), pemphigus, pityriasis rubra. Deep inflammations (furunculus).—Ulcers (independent of struma and syphilis), onychia.
    (2) New Formations:—Varix, nævus, verruca, callositas, clavus, cornu, ichthyosis, scleroderma, elephantiasis Arabum, E. Græcorum, molluscum contagiosum, fibroma molluscum, cicatrix, cheloid, cysts, scirrhus epithelioma, tumors of other kinds.
    (3) Hemorrhages. Purpura.

Distribution of Eruptions.—In examining a cutaneous eruption, it is a great advantage to see the surface of the whole body, or as much of it as possible. Special abundance of it on certain parts, or the special exemption of others, affords at times considerable assistance in the diagnosis. We can in this way also detect the symmetrical character of many eruptions, or the essential local disposition of others—as when the hand is affected by some irritant encountered in a trade, or when the eruption is caused by stockings with analine or arsenical dyes. Some eruptions, again, follow the course of certain nerves, and in zona we have usually a pretty strict limitation to one-half of the body, the eruption stopping at the middle line both before and behind when the trunk is involved. But in addition to the general view of the surface, special regions must be examined for special eruptions. Of the febrile rashes, some show first on the face (variola and morbilli), but most of them appear first on the trunk, so that we much search the chest, abdomen, and back, and we should also examine the arms at the anterior aspect of the elbows, &c., where the skin is delicate. We look at the elbows and knees particularly in psoriasis; at the chest and back in syphilis; at the clefts of the fingers in scabies, to see if any little furrows are present, and also at the inside of the thighs, the wrists, ankles, and umbilicus in this affection; between the shoulders in phtheiriasis; over the chest in pityriasis versicolor; on the head in ringworm and favus;

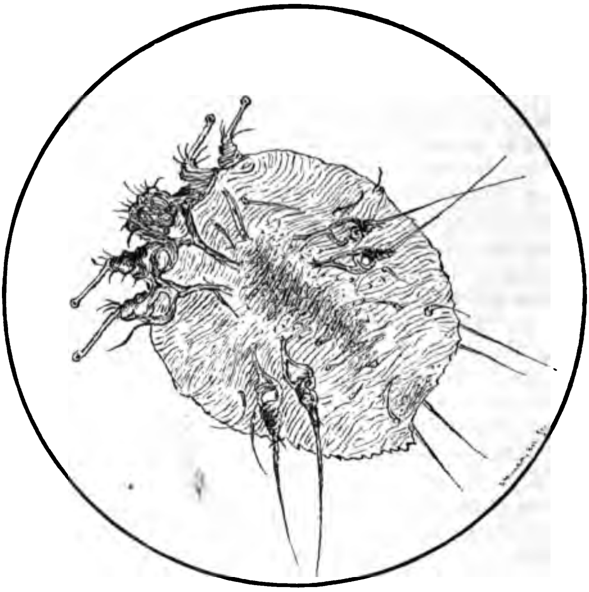

Fig. 18.—The itch insect. *Acarus Scabiei.* Female; ventral aspect. (Drawn by Dr. John Wilson.)

over the shins in erythema nodosum; on the face and shoulders in acne, etc.

The constitutional disturbance and the general symptoms associated with cutaneous eruptions must be carefully inquired into. Pyrexia, headache, and perhaps delirium, pain in the back, sickness, vomiting or shiverings; and pain, burning, tingling, and itching in the parts affected are the most important. Intense pyrexia often precedes the appearance of the rash in the eruptive fevers and erysipelas, and (as mentioned in the section on Pyrexia), the skin must then be carefully examined by good daylight, if possible, for any appearance of a rash. The inspection of the skin for a febrile rash should, in the first instance, be made at such a distance (2 to 3 feet) that the general appearance of the surface can be seen, rather than the minute alterations in the skin; these may be subsequently examined if necessary. Pain in the back and vomiting are specially suggestive of smallpox; intense headache of typhus; sore throat and vomiting of scarlatina; coryza and catarrh of measles; shiverings may occur in the early stage of any of these, and also in erysipelas. But even in those forms of eruptions, more usually called diseases of the skin, there may be much constitutional disturbance, with considerable pyrexia and some gastric disorder, as in eczema and urticaria. The intensity of the general symptoms bears a much more distinct relation to the extent of the cutaneous affection in these cases than in the eruptive fevers. Severe neuralgic pains sometimes precede, sometimes follow, the eruption of herpes zoster. Considerable pain is often experienced in eczema, but in such a case the cause is apparent.

Itching is an important fact in cutaneous disease. It is seldom very troublesome in the eruptive fevers, although often present in measles, smallpox, and chicken-pox. It is seldom marked in syphilitic eruptions, so that its absence counts for something in the diagnosis. In urticaria, psoriasis, and eczema, itching is often very troublesome. In parasitic diseases it is a very prominent feature, especially in scabies and phtheiriasis. The existence of itching can usually be recognized by the presence of a "pruriginous eruption" due to scratching, and the marks of the nails often tell the same story; this irritation alters the appearance of an eruption very materially, chiefly by causing inflammation. Itching, however, may exist without any eruption. In some of these cases, this may be due to a nervous affection of the skin, the pruritus varying much at particular times. Pruritus, especially at the intestinal and genito-urinary orifices, may be symptomatic of disease of the womb, stone in the bladder, diabetes, piles, or other affections of the rectum. In many cases, especially (although not exclusively) in children, itching at the anus is due to the presence of thread worms; in them it is often associated with itching at the nose also, as manifested by picking at the nostrils. But this picking occurs also in diarrhœa and other forms of intestinal irritation.

Itching is occasionally present to a troublesome extent in jaundice; it is not unfrequently produced by the internal use of opium and morphia in all their forms. Some persons are especially liable to this inconvenience in the use of opium. An itching of the eyelids is one of the indications of the action of arsenic.

CAUSES OF CUTANEOUS ERUPTIONS. INFECTION, MEDICINE, FOOD. In inquiring as to the cause of eruptions, we may ascertain the patient's ideas on the subject, or we may interrogate him as to special points in connection with special forms of disease.

Infection.—In the group of eruptive fevers we inquire for any similar illnesses in the same family or neighborhood. Some assistance is at times obtained by learning that the patient has formerly had certain specific fevers, as a second attack in some of these is but rarely met with. (See p. 106.) In suspected erysipelas, we inquire for exposure to this disease in surgical wards, or otherwise; and for any contact with puerperal fever or pyæmia, especially if our patients are predisposed to infection by open sores, &c. In children, and especially in hospital practice, where infection may be present, wounds or open sores predispose, apparently, to the occurrence of scarlatina, which may be mistaken for erythema or erysipelas. In syphilitic eruptions we may inquire for the history of the original infection in the patient, or in the parents, and in the brothers and sisters in the case of congenital syphilis; in this last variety, the occurrence of abortions *before* the birth of the patient is often an important indication of syphilis. But in addition to cases of this kind, we can sometimes trace the infection of a patient from secondary or congenital syphilis. A nurse's arm may be infected from the sores on an infant's anus, or the nipple from the sores on the child's mouth, or *vice versa.* In impetigo contagiosa the patient may inoculate one part from another by means of scratching. The occupation is important in connection with cases of suspected glanders, malignant pustule, &c.

In parasitic diseases we often gain considerable assistance from the knowledge of their having spread by infection. Thus, if two persons sleep in the same bed, scabies is almost certain to be communicated from the one to the other. This disease is often communicated by infected bed-clothes, apart from any direct contact with patients so affected. In ringworm the affection often spreads from the use of the same hair-brushes, although the patients may not otherwise be much associated; ringworm of the body may appear in those who are attending on children affected with it on the head. In favus the contagion may be derived from some pet animal as well as from a patient. The pediculus pubis is sometimes found in persons of good position from their consorting with prostitutes. The itch insects, and pediculi corporis often continue to act on the patient through the medium of the underclothing and the bed-clothes, even after those on the skin have been got rid of. Certain varieties of the same parasitic disease must be borne in mind while searching for the history of infection—thus we have ringworm of the head, of the body, and of the beard.

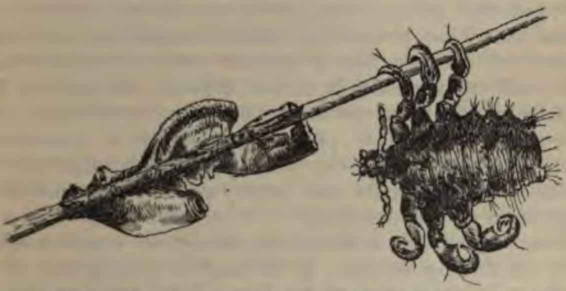

Fig. 19.—*Pediculus pubis*, or Crab Louse, with ova adhering to the hair. (Drawn by Dr. John Wilson.)

Certain medicines and articles of diet are apt to produce cutaneous eruptions. Shell-fish, preserved salmon, cucumbers, walnuts, game, and various other things produce at times an eruption of urticaria or erythema. Some persons, indeed, are particularly liable to this effect from special articles, so that it is almost certain to follow their use; in others, the effect is less certain. These eruptions sometimes simulate the specific fevers; the absence of constitutional disturbance in proportion to the rash, and the absence of the special features of the specific fever simulated may sometimes guide us in the discrimination. Of medicines, iodide and bromide of potassium, belladonna and atropine, sulphur, arsenic, tar, and copaiba may be named as all producing at times cutaneous eruptions.

Iodide and bromide of potassium produce pimples (acne) which appear chiefly on the face and shoulders: occasionally the eruption is more distinctly pustular. The affection of the mucous membrane of the nose and eyes and the swelling of the glands behind the jaws, sometimes guide us in the recognition of iodism.

Belladonna and atropine produce at times a distinct erythema somewhat resembling that of scarlatina; a certain similarity to the eruption of measles is found in some cases. This rash may result from the internal use of the drug (usually in full doses), or from the action of external applications in the form of plasters, especially if excoriations exist on the skin. Dryness of the fauces and more or less dilatation of the pupils are usually present to assist in the recognition of this eruption.

Arsenic produces, although but rarely, an eruption somewhat resembling eczema, or at least a prominence of the papillæ with congestion of the skin. In certain cases herpes zoster has appeared to be due to the use of arsenic, and pityriasis rubra has also been known to supervene in connection with its administration. Puffiness and itching of the eyelids, sickness or pains in the bowels, and whiteness of the tongue assist in the recognition of arsenical influence. Local irritation from arsenic may manifest itself by ulcerations of the part affected.

Sulphur and tar are said to produce at times an eruption resembling a badly developed eczema.

Copaiba gives rise in some cases to urticaria of the usual kind, but the white parts of the wheals may be absent, so that the rash is only red; at times this eruption closely simulates measles in its general appearance, but it does not specially affect the face and is not associated with catarrh. Copaiba is so much used in the treatment of gonorrhœa that when we see an eruption associated with this disease we should always suspect the action of this drug. Nitrate of silver administered internally may cause a dark discoloration of the skin affecting the parts exposed to the light.

In addition to the above a great many remedies produce eruptions from their local action if applied to the skin.

AFFECTIONS OF THE HAIR; EXAMINATION OF VEGETABLE PARASITES.—Absence of the hair is termed "alopecia." This is sometimes, although very rarely, almost universal, affecting even the minute hairs in every part of the body (alopecia universalis). The baldness of advancing years, and premature baldness, which is often hereditary, need only be mentioned. The loss of the hair in syphilis, and after fevers and erysipelas, is usually only temporary, but sometimes a partial baldness becomes permanent in this way. Limited patches of baldness on the scalp, and more rarely of the beard, assuming a circular form, or at least with circular margins, are termed "alopecia areata;" in this affection the hair is quite absent in the fully developed affection, the skin being quite smooth and even glossy. It is supposed by some to be due to a parasite (Microsporon Audouini), by others it is regarded as a neurosis. In ring-worm and favus the hairs are not quite absent, the bald patches present some stunted hairs. In favus the hairs are found, in a typical case, to pierce a cup-shaped yellow crust near its centre; this sulphur-colored crust frequently has a mouse-like odor; patches of red, irritable, shining skin may be found where the hair follicles have been destroyed.

In ring-worm the hairs resemble stubble, being dry and withered; the brittle hairs break off short; there is often fine white dust at their bases, and the skin between them presents an appearance like that of a plucked fowl.

In examining hairs, scales, &c., for vegetable parasites certain precautions should be used. A diseased hair should, of course, be selected if possible for the examination; we judge by its stunted, brittle appearance, and by its looseness on extraction. In examining scales, too much of them may render the specimen rather opaque; the scales and even the hairs may have to be dissected by needles to expose the parasitic growths. Digestion in a solution of caustic potash renders the specimen more transparent. In certain cases it is very desirable to get rid of the fat about the hair or the scales, as the small oil globules simulate vegetable spores. To remove these sulphuric ether may be used, either before the application of the potash or after it, the specimen being dried from the one before the other is applied.

In examining for vegetable parasites, we search for spores (conidia); these are small globular bodies, usually arranged in groups or clusters, or in rows; when rows of these exist they may give off branches (sporidia). Branching tubes, often of a very fine thread-like structure, constitute the "mycelium" or "thallus" of these vegetable growths; they vary much in diameter, and often interlace in the most intricate manner. These growths are not destroyed by caustic potash, alcohol, ether, or chloroform; in doubtful cases, where fat, blood, or pus may simulate spores, these re-agents may be absolutely required for the discrimination. Foreign bodies containing vegetable fibres may sometimes simulate mycelium, but care in selecting the specimen and the absence of branching usually prevent error.

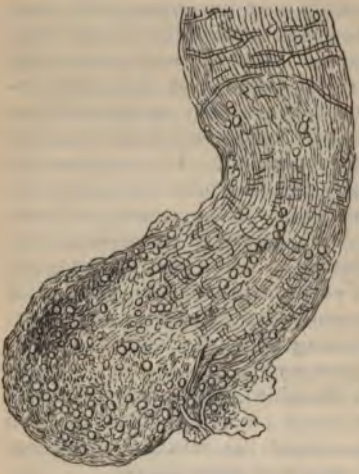

Fig. 20.—Portion of hair from a case of Favus—*Tinea Favosa*—showing spores of vegetable parasitic growth — *Achorion Schönleinii*. (Reduced from Bazin.)

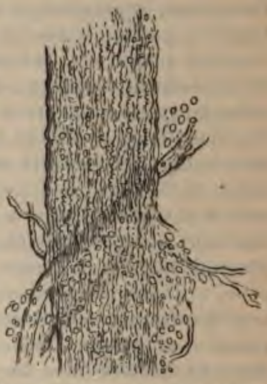

Fig. 21.—Portion of hair from a case of Ringworm — *Tinea Tonsurans*, or *Tinea Tricophytina*—showing vegetable parasitic growth (with sporules infiltrating hair, and a fragment of a tubular growth)—the *Tricophyton tonsurans*. (Reduced from Bazin.)

FEBRILE RASHES.

Certain specific febrile diseases are characterized by the appearance of a cutaneous eruption. They are typhus, enteric, and scarlet fever, measles, smallpox, and chickenpox; erysipelas may also be included in this list for our present purpose. In addition to these, cutaneous eruptions are *occasionally* seen in relapsing fever and in diphtheria; some have alleged the occasional presence of an eruption in pneumonia and acute tuberculosis, but this must still be reckoned doubtful. In all of these diseases the eruption is preceded by constitutional disturbance and the general signs of fever, especially by pyrexia, shiverings, sickness, and vomiting, headache, pain in the back, and general malaise, delirium, and great nervous disturbance; convulsions are often met with in children. Certain of these symptoms are more pronounced in some fevers than in others, and several of them may be almost absent in certain cases. In addition to those which may be regarded as common to all, special symptoms are found in special fevers, as the sore throat of scarlatina and diphtheria, the catarrh and coryza of measles, and the diarrhœa of enteric fever. The history of infection and of previous attacks of special fevers sometimes guides our diagnosis. The date at which the rash appears, or its absence at a given time, constitutes an important element in the differential diagnosis. But in considering the following dates some allowance must be made for uncertainty in fixing the correct date of the illness; for a slight variation from the average date of the eruption; and also for the occasional delay of the eruption quite beyond its usual term, or even for its non-appearance, its suppression, or its fugitive character (especially in malignant scarlatina).

Subject to these qualifications, which are indicated more fully in the remarks on the eruptions in detail, the following dates may be given:—

DATE OF APPEARANCE OF THE FEBRILE RASHES AFTER THE FIRST SIGNS OF ILLNESS.

Scarlatina Rash appears on the first or second day.
Smallpox appears on the third day.
Measles appears on the fourth day.
Typhus appears on the fifth day.
Enteric Fever appears on the seventh day or later.

Chicken-pox usually shows itself within the first day after the constitutional disturbance, but this is often so slight as not to be clearly marked.

German Measles (Red Measles, Rötheln, Roseola, &c.) may appear on the second, third, or fourth day, or the rash may be amongst the very first symptoms.

Erysipelas varies considerably as to the date of its appearance on the skin, but may usually be detected on the day after shiverings or other febrile disturbances have appeared. Occasionally, however, the rash is delayed or suppressed, or appears only as fugitive patches which readily escape notice, just as happens in certain cases of scarlatina.

PERIOD OF INCUBATION.

This is not always uniform, and in many cases cannot be determined with accuracy, as the infection may linger in the clothing or other materials (fomites), after the direct exposure of the person to the disease.

Scarlatina: incubation period varies from a day to eight or ten days: apparent prolongation for a longer period (which is not unusual) can often be explained more naturally on the supposition of infection through clothing and the like.

Smallpox: thirteen or fourteen days.

Varicella, or Chicken-pox: ten to fourteen days.

Measles: usually about a fortnight; said to be seven days when inoculated from nasal mucus; variation in extreme form seven to twenty-one days.

German measles (Rötheln): varies from seven to fourteen days.

Typhus fever: varies from a single day to nearly three weeks; usually about seven to fourteen days.

Enteric fever; about two or three weeks.

Erysipelas: period very uncertain; probably short, as a rule.

LIABILITY TO SECOND ATTACKS.

Scarlatina: an indubitable second attack very rare, but not unknown; dubious illness sometimes called scarlet fever may account for most of the so-called second attacks.

Varicella or Chicken-pox: a second attack extremely rare.

Typhus fever: a second attack extremely rare, but not unknown; the common confusion between typhus and typhoid (enteric) fever must be remembered in judging the history of patients.

Smallpox: a second attack apparently not very uncommon; errors in the diagnosis from other forms of pustular eruptions are quite possible. Traces of former attacks are usually quite visible.

Measles: a second attack, as alleged, is very common; possibly

this may arise from there being two forms of measles with distinct powers of infection (see Rötheln or German measles).
Enteric fever: one attack does not seem to protect from a second (relapses are also very common).
Erysipelas: one attack seems rather to predispose to a second than to afford exemption.

The Scarlatina rash, when well developed, presents a bright uniform redness very similar to that of a boiled lobster. In the early stage a multitude of minute red points can often be recognized, but these soon coalesce and present an uniform redness. The rash usually appears first on the chest, abdomen, neck, or back. It sometimes comes out first on the legs. It disappears on pressure—pressure with the fingers, or strokes with the nails leaving white marks. In the progress of the rash it extends from the trunk to the arms and legs, and frequently can be seen to have, as it were, fresh developments, fading in one part while extending to others, and varying in brightness at different times. Towards the end of the first week it usually begins to fade, and disappears as a rule before the tenth or twelfth day. After the rash fades desquamation begins, and this is usually in proportion to the severity of the rash. (Desquamation, arthritic pains, and albuminous urine often point to the scarlatinal nature of a rash previously regarded as trifling.) At times the scarlatina rash is so faint and evanescent as to be difficult of recognition. Examination by good daylight is very important in such cases. In malignant forms the rash is sometimes very dusky or almost petechial; in other cases it is patchy and shifting in its appearance. In the puerperal form the rash may not be noticeable, or may only be traceable as slight patches on the hands or elsewhere.

The rashes most likely to be mistaken for scarlatina are the belladonna rash, the eruption of urticaria when the white parts of the wheals are absent, and some forms of erythema. This last disease has probably sometimes been the real affection in patients said to have been repeatedly attacked by scarlatina. In young infants a transient erythema or roseola simulates scarlatina: its repetition and the absence of sore throat serve to guide us. In German measles, the rash often resembles scarlatina so closely that it cannot be discriminated in the later stage of the eruption. In all cases of doubtful rash, the character of the tongue, and especially the presence of sore throat, with patches on the tonsils or ulcerations, constitute most important guides; indeed, when the rash is copious we must have great hesitation in admitting its scarlatinal nature if there be no sore throat. Constitutional disturbance and pyrexia are present in all degrees in scarlatina, and sometimes are so slight as to evade our recognition. Subsequent desquamation or peeling of the skin about the fingers or elsewhere, and the occurrence of albuminuria about the tenth to the twentieth day often clear up the nature of a doubtful rash. A previous attack of scarlatina is not an absolute protection from this disease, but it is rare to find clear evidence of a second attack.

An eruption of roseola, somewhat resembling that of scarlatina, sometimes appears before the smallpox rash comes out. It is likewise found after vaccination, and revaccination. A similar redness is noticed occasionally in enteric fever in its early stage, and in connection with relapses. (Roseola exanthematica.)

The Smallpox eruption (Variola) appears as a rule on the third day, but sometimes on the second, fourth, or fifth. In serious cases it appears early as a rule. The stage of incubation is usually a fortnight. Occasionally a "roseola" precedes the true smallpox eruption, giving rise to the idea of scarlatina. The appearance of the smallpox rash is usually associated with a distinct, and often with a very great diminution of the previous febrile disturbance, unless, indeed, in the graver forms, where the decline may be scarcely noticeable. The eruption appears first on the face and neck in most cases, but sometimes on the palate, the wrists, or the trunk; it spreads to the other part in a day or two. At the beginning the eruption consists of red papules; these can be felt to be hard, like small shot embedded under the skin. The pimples in the course of a day or two become vesicular, but the contents rapidly become purulent, and an area of inflammation (areola) appears around the pustules; considerable swelling and itching of the skin usually accompany a severe eruption. When the pustules run into one another they are called "confluent," when they remain quite separate the term "discrete" is applied. A depression in the centre of the pustule usually becomes apparent soon after it is formed, but this "umbilication," as it is called, does not always occur, and sometimes it becomes effaced. Each pustule is multilocular. The "maturation" of the pustule occurs about the ninth day. As the pustules shrink scabs are formed, and when these separate dark-colored stains remain for a time. Depressed marks or "pits" are left in proportion to the severity of the case. The smallpox papules may often be felt in the roof of the mouth, the soft palate, and the tongue; the eruption occurs, also, in other parts of the mucous surface. In severe cases hemorrhages are seen under the skin as well as inside the pustules. Hemorrhages from the mucous membranes and a few papules may be the only manifestation of hemorrhagic smallpox.

In smallpox modified by vaccination, the eruption is usually less abundant and is not often confluent. The constitutional disturbance may be considerable or but slight. The eruption may closely resemble that of unmodified smallpox, or it may consist simply of a few abortive pimples without any proper vesication or pustulation. Vaccination and revaccination lessen the chance of contracting smallpox very materially.

Chicken-pox (Varicella) resembles smallpox in many respects, but it is essentially vesicular, although it may be pustular where irritated; the hard nodular papules are usually absent. The eruption has no special preference for the face but rather for the shoulders, back, and hairy scalp. The vesicles are preceded by an eruption of red spots, but slightly elevated: the lesion is altogether much more superficial than in smallpox and there are no dissepiments in the vesicles. The eruption usually appears within twenty-four hours of the preceding disturbance, if there has been any, but as a rule this is slight. A succession of separate crops of the eruption can often be recognized from their being present in different stages. It is an infectious disease, but usually attacks children only. It is not prevented by vaccination, and does not protect the patient from smallpox.

The chief difficulties in the diagnosis of smallpox arise in the slighter forms, occurring in vaccinated persons, as the few pimples which appear may be regarded as trivial, especially if the patient be subject to acne. In some forms of measles a certain resemblance to smallpox arises from the papules in the early stage being usually hard, or from the dusky hue and hemorrhagic tendency of the rash. In some forms of smallpox also, the rash resembles measles from a transient efflorescence forming a basis for a subsequent papular eruption. The presence or absence of the shot-like papules peculiar to smallpox and the subsequent course usually guide us aright. A pustular eruption in syphilis sometimes resembles smallpox very closely, especially when it appears after great general disturbance. An eruption from iodide of potassium, usually papular but sometimes pustular, occasionally simulates smallpox. The presence of the loculi and the umbilication in smallpox pustules are often useful in guiding us.

Chicken-pox and smallpox, although usually differentiated easily enough, are sometimes quite undistinguishable in the modified form of the disease, at least in isolated cases.

The Measles eruption appears usually on the fourth day, and corresponds with an exacerbation of the prodromal fever. It appears almost always on the face first. It consists of elevated red spots or patches, which tend to assume a circular or crescentic outline. At first the skin between the spots is not red, but it usually becomes so in some parts, and the elevated patches often coalesce. The eruption spreads from the face to the trunk, and from the trunk to the limbs. It may be three or four days before the rash attains its maximum extent, and it may be fading in some parts as others become affected. The rash fades on pressure in ordinary cases, but in grave forms the eruption may be dusky and even petechial. Considerable swelling of the skin of the face is usually obvious in measles. The coincident phenomena generally guide us aright in the early stage or in doubtful cases; running at the nose and eyes, sneezing, cough, and bronchitic râles are very common. In cases with a receding or undeveloped rash we have, at times, grave nervous disturbance.

The eruptions most likely to be confounded with measles are copaiba rash (see p. 102), typhus, roseola, and hemorrhagic smallpox in the early stage.

The German Measles rash (rubeola notha, roseola, rötheln, rosalia) resembles at times measles and at times scarlatina, or it may begin with a resemblance to measles and become very like scarlatina. It does not show such a preference for the face as measles, and the crescentic character is less marked. The rash may be very abundant with but a moderate temperature (102° or 103° F.). It usually appears about the same time after the beginning of the febrile disturbance as a scarlatina rash, but may be somewhat later. There may be slight sore throat, but seldom any ulceration. There may be slight bronchial catarrh. The symptoms, like the rash, present a combination of the peculiarities of scarlatina and measles, but the whole disease is usually mild and of short duration, and the rash disappears in three or four days. The disease is communicated by a special infection evidently different from that either of scarlatina or measles, and a previous attack of one or both of these diseases does not protect the patient from German measles. It is probable that this disease is often involved in the not uncommon reports of children having had measles twice. This form of eruption is sometimes confused with a copious typhus rash, as well as with scarlatina and measles. It also resembles the copaiba rash.

The Typhus rash appears from the fourth to the seventh day, usually about the fifth day from the first signs of acute illness. The rash is but rarely absent in typhus fever, except in mild attacks in young patients, and its extent and depth bear a distinct relation to the severity of the case. It is, however, very apt to be overlooked by the inexperienced owing to its delicate tint, to its brief duration in some cases, or to the absence of good daylight for the examination. Sometimes the inexperienced look too closely into the skin, and so fail to see the mottled rash, which becomes more evident when looked at from a little distance. A dirty condition of the skin, and the presence of flea bites, also render the recognition of a typhus rash more difficult. Flea bites, indeed, present a considerable resemblance to typhus spots in certain stages, but the central minute dark dot or bite can often be recognized; flea bites also are generally aggregated on covered parts of the body. Before the rash appears in a definite form there is often a congestion or redness of the skin, well shown on pressing with the fingers, especially over the back, the chest, and the belly. This condition is associated with suffusion of the eyes, and a dingy complexion.

There are two elements in the typhus rash, which, however, are not always both present—these are definite spots and a more general mottling. These spots, when seen *immediately* after their appearance, are usually red, perhaps slightly elevated, and they disappear on pressure. They vary in size up to about a quarter of an inch in diameter, and are irregular in their form. In a day or two they become dirty looking, and cease to disappear on pressure. Fresh spots may appear during the first two or three days of the eruption, but these are superadded to the first ones, which remain. The spots ultimately become bluish or reddish-brown in color, and distinct petechiæ or subcutaneous hemorrhages are not unfrequently developed in the typhus spots. In addition to the distinct spots just described, we usually have, soon after they appear, a general mottling of the skin, as if there were a "sub-cuticular" eruption of minute spots. This, indeed, may be the only eruption visible in certain cases, especially in the mild forms. This mottling requires a good light for its observation, and the chest and abdomen should be well bared for the examination; pressure of the fingers is useful in ascertaining the presence of this rash. The term "mulberry rash" has been used as descriptive of the general appearance of the typhus eruption. The parts on which the eruption first appears are the trunk, more especially on the front, the parts about the front of the shoulders, and sometimes even the arms and hands. The legs, and particularly the face, are less affected, but when the rash is copious the distribution may be very general. The rash persists for about a week after its appearance, fading somewhat as improvement begins, or becoming blue, dark, or petechial as death approaches, and the spots continue to be visible on the dead body if the rash has existed for some time.

A second attack of genuine typhus is very rare, but owing to the frequent confusion of enteric fever, and perhaps pneumonia, with this disease, the mere fact of a former attack being alleged cannot be much relied on; but special inquiries as to the place in which the illness occurred, and as to its symptoms, may clear up the doubts.

The eruptions most likely to be confused with typhus by the inexperienced are those of measles, German measles, and flea bites. A rash somewhat resembling that of typhus appears occasionally in relapsing fever. A much more common error, however, consists in overlooking the presence of the rash altogether.

The Enteric Fever eruption is almost never very obtrusive, and so it is seldom noticed by the public; as a rule it requires to be carefully looked for. It appears chiefly on the trunk, and especially on the abdomen, but an examination of the back sometimes discloses the only spots visible. The eruption consists of small circular rose-colored papules (lenticular spots) not exceeding one-eighth of an inch in diameter; they are slightly but distinctly elevated; they fade, or almost disappear on gentle pressure, and they fade in this way so long as they last, differing in this respect from the typhus spots. The number of these spots in a case of enteric fever varies exceedingly; in some cases only two or three such papules can be found on a careful search of the whole body, and in others there may be twenty or thirty on the abdomen. The abundance of the eruption bears no relation to the severity of the case. Some cases present only one or two spots, although carefully examined every day, and not very unfrequently no eruption can be found at all. The spots appear in successive crops, each crop lasting about four or five days before disappearing. This feature of a succession of rose spots is most important in the diagnosis. It can be demonstrated by marking with ink all the spots visible to-day, say with a circle, those which appear to-morrow with a triangle, and those which appear next with a square; by the time these last appear, the first marks will be found empty or containing only the merest trace of a spot. This eruption seldom appears before the seventh day of the fever, but its appearance is often much later. Fresh eruptions may continue to appear until convalescence is fairly established, and they may appear during a relapse, even although none were present in the first attack.

In addition to those rose-colored lenticular spots, very delicate blue patches (taches bleuâtres) have been described in this fever as appearing on the abdomen, and an eruption of sudamina is regarded by some as very characteristic of this disease, but these last are found in various other affections. (See Sudamina, *infra*.)

The chief sources of fallacy in connection with the eruption of enteric fever are:—(1) An imperfect examination of the trunk of the body. (2) Mistaking the presence of accidental pimples for true "rose spots;" the marking and subsequent observation of these bring out their difference. (3) Typhus spots when freshly out sometimes resemble "rose spots," as they fade on pressure at this time, but become persistent after a day or two. There is no mottling between the enteric rose spots. (4) An abundant eruption of "rose spots" has sometimes been confounded with a typhus rash.

(Enteric fever is contagious probably chiefly through the intestinal excretions; it frequently affects various inmates of a house about the same time, and arises very often from bad drains or leaking soil pipes and contaminated water supply. This may operate in poisoning milk, which seems to be a very suitable vehicle for the propagation of the poison. A previous attack does not seem to afford exemption from a second.)

Sudamina or Milliary Vesicles are minute accumulations of the secretion from the sweat ducts, arising from obstruction to their openings. They vary in size, but are seldom larger than a pin-head. They can be felt as giving a roughness to the surface, and can be seen in good light as glittering points. Their contents are usually clear; occasionally there is evidence of inflammatory action in their contents being opaque and their bases inflamed. (This condition has been separated from sudamina by some, and named "miliaria.")

This eruption is found in various diseases, characterized by much sweating, and has no specific significance, although formerly regarded in this light. Sudamina are common in enteric fever, acute rheumatism, phthisis, and after childbirth.

Erysipelas is characterized by redness of the skin, the inflammation has a deeper seat than in erythema, and there is usually very considerable swelling and elevation of the affected part. The redness is usually pretty sharply defined by a line bounding the part affected, and it extends, as a rule, in a continuous way from one part to another. Vesication is not uncommon in erysipelas if severe, and even the deeper subcutaneous tissue may be involved in the more serious forms (phlegmonous erysipelas) which are met with in surgical practice. Erysipelas often extends from wounds or sores, especially when it arises from infection; but it may be idiopathic, and it seems at times to arise from direct exposure of the part to cold. In medical practice it is usually found attacking the head and face, causing much swelling of the loose tissues about the eyes and nose. Or it may attack a limb, or beginning in one leg it may spread up the thigh, and crossing over come down the other leg. It occurs in newly born children, spreading sometimes from an unhealthy umbilicus, but it may appear in older children also, apart from any open sore. It may attack puerperal women, who are specially liable to such infection, and in some cases of undoubted erysipelas no rash may be visible. Sometimes in grave forms of erysipelas the patches of redness are irregular and fleeting, readily escaping notice. In connection with dropsy of the legs, whether the skin gives way or is punctured, and sometimes apart from any oozing erysipelas often forms a grave complication.

STAINING, PIGMENTATION, AND DISCOLORATION OF THE SKIN.

Subcutaneous hemorrhages are recognized by their being unaffected on pressure. When small, the words "petechiæ," or "ecchymoses" are used; when large, the term "vibices" is sometimes applied. These hemorrhages are found in typhus fever, in smallpox, in purpura, in scurvy, in diseases of the liver and spleen, and in the terminal stage of dropsy and other exhausting diseases. We must examine for any history of hemorrhage from the nose, gums, or bowels in cases of purpura (see Hemorrhages, Chapter ix.); and we may sometimes find sub-mucous hemorrhage in the mouth. Purpura also occurs in connection with rheumatic affections of the joints. In suspected scurvy we inquire for a history of deprivation of vegetables and milk; this may readily occur in laborers, who often live on tea, and bacon, and bread. The presence of spongy gums, and fetid breath, and the existence of pain and hardness near the hemorrhagic patches, especially in the calf, usually guide us aright. In disease of the liver, leukæmia, &c., the spots of hemorrhage seem due to a depraved state of the blood. In typhus fever, smallpox, and measles, subcutaneous hemorrhage is an indication of the gravity of the attack.

Port-wine stains, nævi, moles, &c., need only be mentioned here. Their existence since childhood and their general appearance usually prevent any misconception.

Discoloration of the skin sometimes results from external agencies, as the application of iodine or nitrate of silver. Frequently repeated poulticing and blistering may likewise give rise to a dark mottling or discoloration of the skin. On the legs, especially of old people, but also in some others, we often find considerable discoloration and mottling from the patients sitting much with their legs near the fire.

Of medicines administered internally, nitrate of silver may be mentioned as giving rise to a dark bluish discoloration of those parts of the skin exposed to the light. This is a rare accident nowadays, but with such a discoloration, especially in one subject to epileptic fits, we must inquire whether this remedy had been used.

The discoloration of jaundice is described elsewhere, and some of the conditions most likely to be confounded with it are there referred to. (See Chapter xii.) Chlorosis, syphilis, malarial fevers, and cancers all produce an unhealthy-looking discoloration of the skin.

Great exposure to the air and weather, associated with uncleanliness, gives rise to a darkening of the skin with brownish spots and freckles, and sometimes to a more general and uniform discoloration (vagabondismus). Sailors and others exposed to tropical climates have frequently a swarthy look, and the influence of race must not be forgotten.

In phthisis, also, we sometimes see considerable pigmentation about the cheek-bones and around the orbits. In pityriasis versicolor, there are defined patches of brownish discoloration, with minute scales, situated usually on the chest, or at least on the trunk; the parasitic nature of this eruption can be demonstrated by the microscope (see Fig. 22).

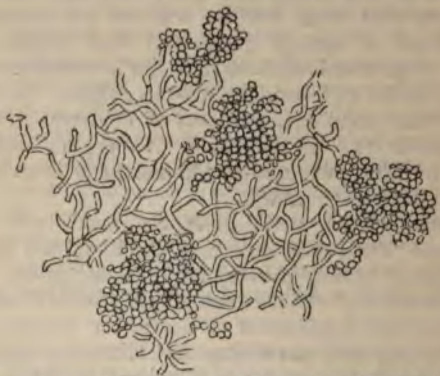

Fig. 22.—*Microsporon Furfur*, the vegetable parasite of Pityriasis versicolor. (Dr. M'Call Anderson.)

Pregnancy is often characterized by considerable pigmentation. It is chiefly marked around the nipple, about the linea alba, and on the face. In uterine tumors, and in other forms of uterine disease, there are often distinct patches of brownish discoloration on the face, chiefly on the brow, but other parts may also be affected (chloasma uterinum).

In Addison's disease, the pigmentation affects chiefly the face, the exposed part of the neck, the backs of the hands, the axillary and umbilical regions, the genitals and the inner aspect of the thighs. This discoloration, as a rule, resembles the tint of a mulatto's face, but in some parts the discoloration is darker. In many cases considerable assistance is experienced by finding brownish stains or black streaks on the buccal mucous membrane and on the tongue and the nipples. The constitutional symptoms associated with the pigmentation in Addison's disease are those of asthenia rather than of emaciation, with great feebleness of the muscles, including the heart itself. Pains in the back and vomiting are not uncommon. The disease is often complicated with pulmonary phthisis, or disease of the vertebræ, but the diagnosis can be most safely arrived at when the prostration and discoloration seem otherwise inexplicable. It is commonest in young male adults; greater care is required in the diagnosis in the case of women, and especially if there be any uterine irregularity. The presence of hepatic or renal disease ought also to make us more guarded in our diagnosis.

White patches of skin may result from cicatrices of all kinds. White streaks are seen in connection with atrophic lesions of the skin, which may be associated with evidence of defective formation elsewhere. White vertical lines on the abdominal walls are found habitually in women who have borne children: they sometimes guide us in forming an opinion as to this fact. They arise from previous distension, for similar streaks are found in persons of both sexes and in children, in connection with former dropsical swellings of the belly. White patches from simple absence of pigment in the skin are named vitiligo or leucoderma. Absence of pigment in the skin, hair, and choroid constitutes albinism.

SYPHILITIC ERUPTIONS.

Syphilitic eruptions assume nearly every variety of appearance found in disease of the skin. It is of more importance to recognize an eruption as syphilitic, than to define its special form.

The following points for such a discrimination are given by Dr. Tilbury Fox: 1. Previous syphilitic infection, as evidenced by the history, by cicatrices of the primary sores, &c. 2. The symmetry of syphilitic eruptions. 3. Their so-called "copper color:" dull red at first, becoming reddish yellow-brown. 4. A tendency to circular form of the patches. 5. The scales when present are very light and small. 6. The crusts are thick, greenish, or black, and adhere firmly; vesicles are flat, and do not rupture readily; ulceration is common, the surface ashy gray, and the edges sharp. 7. Pain and itching in the parts are not usually troublesome. 8. Polymorphism: papules, pustules, and tubercles coexist in the same subject, or one form of eruption gradually assumes the character of another.

As to the different periods of syphilitic eruptions he gives the following chart:—

1st period.—Syphilitic fever, with transient hyperæmia of the skin, giving rise to roseola, &c. (about the same time as the sore throat—a few weeks after infection).

2d period.—Hyperæmia and infiltration about the sebaceous glands—syphilitic acne.

Hyperæmia and deposit in the hair follicles, syphilitic lichen.

Ditto. In the derma—papular, and tubercular, squamous and pustular syphilis.

About the nerves, syphilitic herpes and pemphigus.

3d period.—Characterized by changes in pre-existing syphilitic formations which lead to syphilitic ulceration, exostosis, &c.

In congenital syphilis we look for mucous tubercles at the anus or mouth, red patches or pustules on the buttocks, ankles, or hands, subacute onychia, fissure at the lips; a history of "snuffles" at birth, and the presence of notched teeth or of old keratitis are important.

AFFECTIONS OF THE NAILS.

Affections of the nails sometimes serve to indicate constitutional disorders: there are, also, of course, local affections of the parts.

Curving of the nails is observed along with a clubbed shape of the finger ends, in cases of phthisis; sometimes the curving exists without any of the clubbing referred to. This deformity is not limited to phthisis, but is found in various chronic states tending to atrophy. It may be found in cardiac and aneurismal disease, and in the latter is sometimes on one side only.

Transverse white marks, or thinned portions in the nails, are sometimes clearly seen after serious illnesses, such as fevers, and we may occasionally avail ourselves of them in checking the history or the dates supplied by a patient. A mark of this kind half way up the nail may be reckoned as indicating an illness three or four months previously.

The nails are sometimes shed in pityriasis rubra, and in severe eczema affecting their neighborhood. In psoriasis and pityriasis rubra, the nails are often affected, becoming dingy, thickened, curved, grooved, and dirty looking.

Onychia, inflammation of the matrix of the nail with suppuration beneath it, and loosening of its attachments, is occasionally due to syphilitic disease. Parasitic diseases sometimes affect the nails (favus and ringworm).

GLANDULAR AFFECTIONS.

Affections of the lymphatic glands afford many indications of general constitutional states. They are often, however, merely dependent on *local irritation*. Thus a sore on the foot or leg, perhaps of a trivial nature, may by the strain of walking give rise to enlargement and tenderness in the femoral glands; the anatomical relationship of the lymphatics serves to indicate the connection of these with the leg, instead of the genital organs as might at first be supposed. In the neck, also, the *posterior* cervical glands may be enlarged from the irritation of an eczema of the scalp, past or present, and not as the result of constitutional syphilis. A chain of small hard glands in this situation, however, constitutes an important indication of *constitutional syphilis*, in the absence of any local cause for their enlargement. The inguinal glands are often enlarged, and sometimes proceed to suppuration, from the irritation of a gonorrhœa or of a soft chancre on the penis: indeed, the history of suppurating buboes and the presence of cicatrices in the groin are to be regarded as evidence of some local irritation in the genital organs, rather than a proof of constitutional syphilis; this may, however, coexist with the other. The typical form of glandular enlargement in the groin due to syphilis, consists rather in the presence of a group of moderately enlarged, painless, and movable or rolling glands, which proceed to suppuration only in exceptional cases.

Enlargement of the glands elsewhere may be due to syphilis in the exceptional case of a primary sore being contracted in some unusual situation: a general affection of the whole glandular system is also found at times in constitutional syphilis.

Enlargement of the glands serves as a valuable indication of an affection of the system in certain forms of *cancer and epithelioma;* malignant tumors of the breast affect the axillary glands, malignant growths in the throat affect the cervical glands, and so on. Even deep-seated cancers may reveal themselves by such glandular affections, as in the case of malignant growths at the base of the skull involving the glands in the neck, and cancer of the abdominal organs affecting some part of the lymphatic system within our reach.

Enlargement of the anterior cervical glands is due in the immense majority of cases to *a scrofulous tendency* in the patient, and their presence, or the evidences of their former existence, from the scars and cicatrices left, frequently serve to indicate this constitutional taint. They may, however, be due to some of the other causes referred to in this section. The scrofulous glands sometimes remain chronically enlarged, although free from pain. In persons of a weak constitution, the lymphatic glands are sometimes enlarged from exposure to cold and other comparatively slight causes which would not affect a robust person. Scrofulous glands may occasionally be felt through the abdominal walls in cases of tabes mesenterica.

A generalized enlargement of the lymphatic glands is so often associated with *Leukæmia*, that it is well to examine the blood microscopically when they are thus affected. The relative proportion of white blood corpuscles to the red corpuscles varies greatly even in health, and it is often considerably increased in anæmia and also in cancerous affections, but when the proportion, as estimated carefully in various fields of the microscope, amounts to 1 in 20 or 1 in 10, the case may be regarded as one of leukæmia; the proportion is often higher, and the white corpuscles may even equal the red in number. (See Examination of the Blood, Chapter ix.) In such cases we must see if there is any enlargement of the spleen. Leukæmia may exist with enlargement of the lymphatics alone (lymphatic leukæmia), or with enlargement of the spleen alone (splenic leukæmia), or both forms of enlargement may be present. General enlargement of the lymphatic glands may exist without leukæmia, although dependent on some grave constitutional affection; the name "Hodgkin's Disease" is sometimes applied to this special variety, although it is applied by others in a more general sense to cases of various kinds with lymphatic enlargements (lymphadenoma). In such cases there is sometimes a complication from the presence of a mediastinal or abdominal tumor (lymphoma) of a similar nature; these may give rise to exudations, and so the case may be mistaken for a pleurisy or for ascites occurring in a scrofulous subject.

Enlargement of the cervical glands is of habitual occurrence in *scarlet fever;* it sometimes appears very early in the disease, before the other symptoms have been developed, but usually comes on about the second or third day of the illness, or even later. It is specially marked in the grave forms with serious affection of the throat; in young children, the enlarged glands may appear like a collar surrounding the neck, this is always a very serious indication. Glandular affections in connection with ulceration of the throat, appearing late in the course of the fever, are always of special gravity. In scarlatina, these glands often suppurate, and sometimes cause extremely deep sloughs.

Glandular enlargements in the neck, especially about the angle of the jaw, are sometimes found in *diphtheria* and other forms of sore throat and tonsillitis, but they seldom attain the size or extent common in scarlet fever.

Parotitis.—Inflammation and suppuration of the parotid may be due to scarlet fever, from the general invasion of the glands in this region. It constitutes a sequela of typhus which is not uncommon. It is but rarely seen in relapsing and other fevers or in erysipelas. Parotitis, however, may also be a special affection, due to some specific infection (mumps). This disease attacks children chiefly, especially between five and fifteen years. Sometimes it is unilateral but usually double. There is considerable pain, especially on moving the jaws, and a certain amount of fever and constitutional disturbance is common. This form of parotitis seldom proceeds to suppuration. Occasionally affections of the breast or testicle, by metastasis, have been observed.

Plague, Glanders, &c.—Acute glandular swelling (buboes) in the axilla, groin, and neck are found as a rule in the Plague, associated often with carbuncles and other evidence of serious disturbance, but this disease is not now prevalent in Europe.

Glandular swellings are likewise found in connection with glanders and farcy, as it occurs in men infected from horses, asses, and mules; sometimes pustular eruptions and discharges from the nose appear in this disease.

THE JOINTS.

The joints should be examined in all cases in which they seem painful. When, from the presence of fever or any other cause, we suspect the existence of acute rheumatism, gout, or pyæmia, we must make a careful search in the joints for any swelling or tenderness. In syphilis, also, the history of pain in the joints is often important. The presence of chronic disease of the joints, or the evidence of past mischief in them, may often throw light on the scrofulous or gouty tendencies of a patient; the evidence of old disease in the joints, or former suppuration, may serve to explain the existence of lardaceous disease of the viscera. Local disease of the joints comes for the most part under the care of the surgeon; the discrimination of the various lesions from one another, and from hysterical affections, which occasionally assume this form, must be sought in surgical works.

On the border line between medicine and surgery is the form of disease popularly called "*rheumatic gout*," but more correctly named "*rheumatoid arthritis*," or "*chronic rheumatic arthritis;*" this is characterized by more or less pain, but especially by enlargement of the ends of the bones, and deformity or "nodosity of the joints;" the parts involved are often twisted out of their position. The knuckles are perhaps the parts most frequently involved in the early stage, but all the joints of the limbs may be more or less affected. A certain crackling sensation is often experienced in moving or manipulating such joints. Although essentially a chronic disease, the patient may have acute or subacute attacks; we then find redness, swelling with effusion, and tenderness: in some cases there may be a considerable resemblance to gout. Enlargement of the ends of the bones always implies an old standing affection; osseous deposits may likewise exist in the adjoining ligamentous tissues. The general health is usually deteriorated, and the articular mischief often dates from some debilitating or exhausting illness.

Enlargement of the ends of the bones, and other osseous growths and deformities resulting from spontaneous fractures, are met with occasionally in cases of locomotor ataxy. Chalky deposits in the joints sometimes stimulate the deformity of rheumatoid arthritis, and some doubt may remain in certain cases till the deposits are exposed by ulceration. Enlargement of the ends of the bones, with the appearance of "double joints," occurs in children as one of the characteristics of rickets.

In acute rheumatism (rheumatic fever) pain in the joints is usually an early symptom, although there may be high fever for a day or two before this becomes pronounced. When the pains are present in various joints we can seldom mistake the nature of the illness. But when the joints of the spine seem the only parts affected, we may indeed be in doubt, as pain of this kind often arises from serious disease of the bones, or from certain affections of the spinal cord, or of its membranes. For this reason any case of rheumatism, with acute symptoms, involving the back chiefly, without any swelling of the joints in the limbs, must always be scrutinized carefully during its progress, as many mistakes arise from applying the name "rheumatism" to such an illness; pain in the limbs, with great tenderness on handling them, may be present in the spinal affections referred to, and this tends further to simulate rheumatism; more rarely, cerebral meningitis may be characterized by hyperæsthesia in this way. When the patient is known to have had articular rheumatism, the case is so far simplified; a rheumatic attack may be confined chiefly to the back, but it usually involves other joints also during some part of its course.

Acute rheumatism usually produces very marked swelling, with considerable effusion into the joints, and along with this there is often redness of the skin, and almost always great pain, especially on disturbing their position in any way, so that the patient becomes very helpless, and dreads the least shaking of his bed. The mischief in the joints appears very suddenly; it is sometimes very fleeting, shifting about from one limb or one set of joints to another, or from one side of the body to the other. Relapses are very common in this disease, and one attack predisposes to another. We inquire in cases of this kind for the history of any previous attacks, of any exposure to cold and wet, and also for any hereditary tendency to rheumatism. We must always make a careful search for the evidence of cardiac mischief; this may exist apart from any thoracic symptoms; there is, however, usually more or less pain in the chest when pericarditis is present. The temperature of the patient is very important in rheumatism; a strict watch must be kept on it if it seems to be rising very high. With such an elevation we may have alarming delirium or other cerebral symptoms, although the articular pains may be but slight or may even have greatly diminished. Sweating is habitual in acute rheumatism, and the urine is usually high-colored and loaded with urates.

In children, the affection of the joints in rheumatism is often so slight and fleeting, that the disease is apt to be overlooked, or attributed to "growing pains." In such cases swelling and pain about the feet are often the most marked features. These slight attacks may be complicated with endocarditis or pericarditis, and may lay the foundation of permanent cardiac disease.

Chronic forms of rheumatism are found in elderly people, apart, it may be, from any previous acute attacks. This affection is characterized by pain and stiffness of the joints, and the muscles and tendinous structures are also more or less involved.

Quasi-rheumatic affections of the joints occur in scarlatina and relapsing fever. In the former the articular affection occurs usually after the first violence of the fever is over, and often coincides with the period of albuminuria and cutaneous desquamation. There is not usually much swelling in the joints, but the pain is sometimes very considerable. (For more serious articular affections in scarlatina, see Pyæmic affections of joints, p. 126.)

In relapsing fever, pains in the joints occur at the beginning of the febrile attack, and often add materially to the general suffering. They may also return with the relapse. The presence of high fever and of articular pains in this disease simulates acute rheumatism very closely, but the epidemic character of relapsing fever, and its complete absence for years together in this country, prevent any very frequent errors in this respect. Here also the joints are but little swollen as compared with the usual form of rheumatism. Arthritic pains and swelling occur in connection with purpura (see pp. 115 and 127), and also with the Hæmorrhagic diathesis (see Chapter ix.)

Gororrhœal rheumatism (gonorrhœal synovitis) is comparatively a rare affection. It must not be supposed to include all the cases of chronic articular pains in patients who have had at some time a gonorrhœal discharge. Gonorrhœal rheumatism arises during the period of the urethral discharge. It usually attacks the knee joint, but it may involve various joints in succession, and even the synovial sheaths of the tendons. Its appearance may be marked by a diminution in the discharge. It tends to recur with a subsequent gonorrhœal infection, or even with other forms of urethral irritation, or it may linger as a more chronic affection associated with a gleety discharge, or even after this has disappeared; recurring disease is apt to lead to serious destruction or to stiffness of the joint; although the health suffers seriously, the patients do not often die of the disease. Occasionally this gonorrhœal rheumatism is associated with ophthalmia at its commencement, and with iritis in its later stages. As a rare occurrence we may have true pyæmic synovitis from gonorrhœa, with its usual fatal result.

Gout manifests itself by pain and swelling in the joints, associated with more or less general disturbance; and it appears both in acute and chronic forms. Gout has a special tendency to affect the ball of the great toe, especially in the first attack, but almost any joint may be involved; previous injury renders a joint particularly liable to the gouty inflammation, and this may determine the site of the seizure. The joint becomes exceedingly painful in an acute attack, especially if it be the first; there is usually great swelling, redness or lividity, and tension; the veins are usually much swollen, and after the tension subsides œdema of the part remains, and the skin desquamates. The paroxysms of pain have a marked tendency to nocturnal exacerbations. The fever is usually much less than in rheumatism, and its intensity seems more distinctly related to the local inflammation. General disturbance and especially gastric disorder, characterized by acidity, may be regarded as usual, and cramps in the muscles are not uncommon. Alarming symptoms referable to the stomach, heart, or nervous system sometimes occur in connection with gouty attacks, or with a recession of the articular affection. The fleeting and erratic forms of attack common in rheumatism are not found in gout.

The personal and family history are very important in the diagnosis of gout in doubtful cases. Gout is rare in Scotland except among the upper classes, although not uncommon amongst working men and hospital patients in London. Is is commoner in men than women, and seldom appears till the patient is near 40 years of age. The influence of heredity is very strongly marked. The habits of the patient as to excess in eating and drinking are very important; the use of malt liquors and wines predisposes to gout much more strongly than even a free use of spirits. Excess in the use of animal food is likewise potent in producing gout. The connection of lead-poisoning with gout seems also to be so frequent, in London at least, as to assist in the diagnosis. The occurrence of renal affections in gout is likewise common, and should be inquired into, and the state of the heart and arteries should likewise be investigated.

The test of the gouty condition by finding crystals of uric acid in the serum of the blood is of much value. Dr. Garrod recommends two drachms of the serum of the blood to be placed in a flat glass dish and set aside to evaporate slowly; it is first acidulated slightly with acetic acid, and a fine linen fibre is introduced into it; when the fluid has been reduced to the consistency of a jelly, this fibre is found crusted over with crystals of uric acid if the blood be derived from gouty patients, but there are no crystals from the blood of those free from this taint.

Chronic forms of gout become developed from repetitions of the acute affection. In gout the tendency is for the recurrences to be more and more frequent, with less distinct causes for each attack. The joints also are apt to become permanently changed, particularly from the deposit of chalky masses in their structures. These are called chalk stones or tophi (*i. e.*, concretions); they consist chiefly of urate of soda along with animal matter; their composition may be determined as in the case of urinary calculi. Sometimes these concretions give rise to small abscesses, and in this way become exposed. They are found in various joints. Before they become visible the diagnosis of these hard masses in the joints may be doubtful, as they may simulate some enlargement of the ends of the bones. Assistance is afforded at times by finding similar small concretions in the ear, especially in the helix, varying in appearance from the minutest possible vesicle beneath the skin to a bead-like nodule resembling a pearl.

The constitutional symptoms in chronic gout vary considerably; dyspeptic troubles form the leading feature in such cases.

Pyæmic affections of the joints occur in many cases of pyæmia, as they arise in surgical practice. With these we have no concern here. Affections of this kind occur after childbirth, sometimes at a considerable time after delivery, associated it may be with evidence of suppuration elsewhere (*pelvic abscess, phlebitis, pyæmia, &c.*). Essentially the same kind of articular mischief occurs also sometimes in
tina. This puerperal and scarlatinal form of pyæmic
is is limited to one joint in some cases, but in others

various joints are affected. Such illness, although always serious, are not necessarily fatal. Pyæmic disease of the joints sometimes occurs also after certain forms of pneumonia, with typhoid symptoms, and after enteric and some other fevers. When suppuration is known to be going on in a case, we must always regard articular pains with great suspicion; gonorrhœa has been known to give rise to true pyæmia, and gonorrhœal rheumatism is regarded by some as a mild form of this disease.

Pyæmia, with affection of the joints, sometimes occurs in an idiopathic form, as it may be called, that is, without any obvious cause. In such cases the symptoms may resemble those of enteric fever, although shiverings are usually present in a more pronounced form. In obscure cases it is well to examine the various joints as to swelling, redness and tenderness to pressure.

Pyæmic joints are usually painful, but sometimes the pain is not well marked; tenderness is very generally present even in such cases. The pyæmic affection has none of the fleeting or shifting character of acute rheumatism. Actual pointing of a pyæmic joint may take place.

Articular pains with subcutaneous hemorrhages occur both in purpura and scurvy. There is a form of disease termed "purpura rheumatica," in which further pains and fresh hemorrhagic spots appear together, and there may be hemorrhages elsewhere as well; it is regarded by some as a mere coincidence of purpura with a rheumatic attack. In scurvy the articular pains and stiffness of joints, due to the fibrinous effusions found in this disease, are often so permanent as to lead to the idea of rheumatic instead of scorbutic disease. Affections of the joints are also found in the hemorrhagic diathesis. (See Hemorrhages, Chapter ix.)

Syphilitic affections of the bones and joints occur in a slight form in what is termed the secondary stage. But the more severe and persistent pains occur later, among the tertiary symptoms, when nodes, &c., become developed. These pains usually affect several joints, and especially involve the larger ones; they have a very marked tendency to nocturnal exacerbations, and the pains are often evidently present in the bones, and even in the head, as well as the joints. Other evidences of syphilis usually coexist with these pains when they are severe. This manifestation of syphilis has some value in judging of the history of a venereal complaint.

CHAPTER V.

EXAMINATION OF THE ORGANS OF SPECIAL SENSE — SUBJECTIVE DISORDERS OF THE SPECIAL SENSES — TESTING OF CRANIAL NERVES.[1]

THE EYE.

THE examination of the eye affords indications of the greatest variety and importance. No allusion will be made here to diseases of the eye itself, unless in so far as these bear on general symptomatology, or unless they might lead to confusion or error. (For Subjective Disorders, see p. 153.)

The yellow discoloration of the conjunctiva is discussed elsewhere in connection with jaundice. For the various points bearing on the diagnosis of jaundice, and the color of the sclerotic, see Jaundice, Chapter xii.

Opacities of the cornea, traces of old iritis, and the like, are sometimes useful as indicating, along with notched teeth and other signs, certain constitutional affections, especially syphilis and scrofula. Acute iritis may supervene in syphilitic or rheumatic cases while under observation.

The arcus senilis consists of an opaque ring, or segment of a ring, in the cornea at its junction with the sclerotic. It usually exists in both eyes, when present at all, but it may be present to an unequal extent. It occurs habitually in persons over 60. When present in younger subjects (35 to 50) it is to be regarded as a sign of early degeneration of the tissues; it is very often associated with atheroma, gout, renal disease, and cardio-vascular changes.

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[1] In addition to the general treatises on medicine, those on Physiology also must be consulted for details. See especially Flint's *Physiology*, vol. v., for organs of sense.

General works on Nervous Diseases are referred to in the next chapter. Erb's Treatise on the peripheral cerebro-spinal nerves (Ziemssen's Cyclopædia, vol. xi.) is particularly valuable in this connection.

As regards the Eye, see Sœlberg Wells, Carter, Mackenzie, Allbutt on Ophthalmoscopic Examinatlon of Medical Cases, and Hughlings Jackson's papers in *British Medical Journal*, 1877, vol i.

For the Ear, consult von Trœltsch, Roosa, Dalby, and Hinton lmes's *System*, vol. iii.).

Suffusion of the eyes, with injection of the conjunctiva and lachrymation, is often due to local causes; but we also find it at the beginning of certain fevers, especially measles and typhus. It may likewise constitute one of the early signs of meningeal and cerebral diseases.

Protrusion of the whole eyeball (exophthalmos) may indicate abscess of the orbit or tumor somewhere behind the eyeball; in such cases it is usually unilateral. When it affects both eyes, and when associated with enlargement of the thyroid, and rapidity of the heart's action, it constitutes an important feature in exophthalmic goitre. Considerable variation exists normally in the prominence of the eyeballs.

Inability to close the eyelids properly (lagophthalmos) is very common, but not invariable, in peripheral paralysis of the facial nerve. (See seventh nerve, p. 163.) It is uncommon, although not unknown, in the paralysis of the face of ordinary hemiplegia from cerebral causes.

Ptosis, or droop of the upper eyelid is a sign of paralysis of one of the branches of the third nerve. Sometimes, however, it is not paralytic, being obviously due to some mechanical impediment in the action of the muscles or eyelids themselves. When paralytic it may exist alone, or be combined with other evidence of a lesion of this nerve.

SQUINTING, OR STRABISMUS—PARALYSIS OF THE OCULAR MUSCLES—DIPLOPIA.—In examining for ***strabismus*** we get the patient to direct his vision to a point placed exactly opposite him in the middle line. The observer's finger held in such a position suits quite well. This is tried at various distances, both near and remote, and we notice whether the centre of the cornea coincides with the centre of the palpebral fissure. If a deviation occurs (primary deviation), we should notice whether this comes into more prominence when near or when distant objects are looked at; we also observe whether the eyeball is turned inwards (internal or convergent strabismus), or whether it is turned outwards (external or divergent strabismus); we can usually say at once which of the two eyes is the one whose axis of vision is directed to the object, and which is the one that deviates. Sometimes, however, the patient can fix on the object with either eye indifferently [illegible] either the one or the other may deviate ("alternate squint"). When the same eye is always used to fix on the object there is usually a distinct difference in the acuteness of the vision on the two sides—the better eye being of course selected by the patient for this purpose. If now we get the patient to fix on the object with the less perfect eye, by interposing the hand before the sound one, or by placing a piece of dimmed glass in front of it, we may then find that the sound eye (which was quite straight in the former experiment) deviates inwards or outwards, just as the other did. In many cases this "secondary deviation," as it is called, can be ascertained, by a scale placed below the eyelid, to be exactly equal to the primary deviation; this is the common case when the squint depends on hypermetropia and myopia apart from any paralysis of the ocular muscles ("concomitant squint"); in paralytic squint the secondary deviation is often more extreme than the primary, and this sometimes constitutes an important indication of ocular paralysis. A deviation, however, which originated in a paralysis may be perpetuated as a concomitant squint after the paralysis has passed away; and in rare cases, from the persistence of a non-paralytic squint, and the stretching of the fibres of the muscle, we may find a want of proper movement from simple muscular weakness apart from any true paralysis.

In cases of "*concomitant squint*" there is no impairment of the movement of the eyeballs, and this can be shown by testing the eyes separately—one only being open at a time, and the object looked at being carried up and down, and to the extreme right and left; the free mobility of each eye in all directions may then be ascertained. Strabismus having these peculiarities depends on a want of proper adjustment in the action of the muscles, or on a certain shortening of one or other of them; such a squint depends, in the great majority of cases, on errors in the refraction of the eye, convergent squint being associated with hypermetropia, and divergent squint with myopia. These errors in refraction are in many cases hereditary, so that a tendency to squinting may be inherited. In such cases of strabismus, binocular or stereoscopic vision is usually sacrificed at an early period in the case, and so the patient is not troubled with diplopia. Specks on the cornea, and other defects in the vision often seem to determine the occurrence of squinting and the suppression of the weak eye. Patients with hypermetropia and myopia may also have squinting produced by various acute illnesses of a general nature; this squint may be temporary or permanent. It may thus simulate a cerebral disturbance under certain circumstances.

In *paralytic squint* the movement of the eyeball is impaired in certain directions, so that it cannot be moved outwards or inwards beyond the middle line, as the case may be; the sound muscle, moreover, overbalances the paralyzed one, so that, for example, in paralysis of the external rectus we have often an internal squint, and in paralysis of the internal rectus an external squint. Before concluding that there is ocular paralysis, we must see that no merely mechanical impediment exists to hinder the movements. In paralytic squint the "secondary deviation" already described is often greater than the primary, and when the vision is directed towards the paralyzed muscle, this is often very extreme. Thus, if a person with paralysis of the right external rectus be tested as to his affected eye (the vision of the other being obstructed with a dimmed glass), and if he be directed to look at an object at his extreme right, the nervous energy is directed to the *right* external rectus and to the *left* internal rectus, so as to execute this conjoint movement; as the paralyzed muscle does not respond properly, a still further force is directed to these muscles, and thus the internal rectus of the *sound* eye is led to contract excessively, and quite beyond anything that is required; its pupil may, indeed, be buried within the palpebral fissure.

Diplopia is a common feature in paralytic squint; indeed, diplopia may constitute the only evidence of a slight paralysis of an ocular muscle; for when this "paresis," as it is called, is slight, there may be no discernible diminution of the movements of the eyeball. Diplopia is usually complained of by patients when it is present to any marked extent, but it is sometimes slight, or only developed in certain directions of the vision. Moreover, it is often important to determine the relation of the two images to the respective eyes, and so a careful test is often demanded. A candle in a dark room, placed at different heights, and in different positions to the right or left of the patient, may be used. It is well also to have a piece of red glass to place before one of the eyes, so as to identify each image by its color. If the vision of one of the eyes is less perfect than the other, we place the colored glass before the *sound* eye, so as to render the defective image relatively plainer. The faulty image is usually recognized, apart from this contrivance, by a certain dimness or obscurity as compared with the other; the false image may be placed at the side of the other, or above or below it, or there may be an obliquity in its position; these differences depend on the affection being due to paralysis of the superior, inferior, external, or internal recti muscles, or of the superior or inferior oblique, or to various combinations of these paralytic lesions.

With regard to lateral displacement of the false image, we must ascertain whether the diplopia is "crossed" or "direct." If with the assistance of the colored glass *the image to the right* be found to be that which is seen with the *right eye*, then we call the diplopia "direct" or "homonymous." If with the same test we find that the image identified with the right eye is seen to the left, then we call it "crossed." "Crossed" diplopia occurs in paralytic *divergent* squint, or when there is a tendency to it; "direct" diplopia occurs when there is a tendency to *convergence*.

The images may also be superimposed, the one above the other, and this is usually associated with a certain obliquity in the position of the image seen by the paralyzed eye; this may be slightly "crossed" or not in different cases.

In order to facilitate the investigation of these varieties of paralysis the following details are submitted in a tabular form:—

FUNCTIONS OF OCULAR MUSCLES.

Rectus superior elevates and slightly inverts the eye.
Obliquus inferior[1] elevates and slightly everts the eye.
Rectus inferior depresses and slightly inverts the eye.
Obliquus superior[2] depresses and slightly everts the eye.
Rectus internus inverts the eye.
Rectus externus everts the eye.

Hence we find that the position of the eye or of the pupil varies according to the special muscle paralyzed, when the paralysis is of such a degree as to give rise to deviation, although, as already explained, diplopia may be the only evidence of a slight paresis. Moreover, as this deviation depends on the activity of the sound muscles quite as much as on the weakness of the paralyzed one, the results are not always uniform, as we may have to deal with a double or a complex paralysis. In the following tabular statement only *one* muscle is presumed to be affected, the rest being sound.

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[1] The Rectus superior and the Obliquus inferior are thus required jointly for a pure elevation.

[2] The Rectus inferior and the Obliquus superior are thus required jointly for a pure depression.

RESULTS OF PARALYSIS OF SPECIAL OCULAR MUSCLES WHEN THE OTHERS ARE SOUND.

Paralysis of Rectus Superior: inability to raise eyeball properly above horizontal level; pupil may diverge somewhat downwards, and a little outwards (from action of the rectus inferior and the obliqui).

Paralysis of Rectus Inferior: inability to lower eyeball properly below horizontal level; pupil may diverge somewhat upwards, and a little outwards (from action of the rectus superior and the obliqui).

Paralysis of Rectus Externus: inability to turn eyeball properly outwards; pupil diverges inwards (from action of rectus internus).

Paralysis of Rectus Internus; inability to turn eyeball properly inwards; pupil diverges outwards (from action of rectus externus).

Paralysis of Obliquus Superior: but little alternation in movements of eyeball; slight deviation of cornea upwards and inwards, or simply upwards.

Paralysis of Obliquus Inferior: but little alteration in movements of the eyeball; slight deviation of the cornea downwards and inwards. (Paralysis of the sphincter of the iris, giving rise to a moderate dilatation of the pupil, and to paralysis of the accommodation, often accompanies this form of paralysis; this depends on the branch to the lenticular ganglion being given off from that branch of the third nerve which goes to the inferior oblique muscle. Occasionally, however, this lenticular branch arises from the sixth nerve).

DIPLOPIA IN OCULAR PARALYSIS.

Diplopia is specially, or perhaps only, developed when the vision is directed towards the paralyzed muscle, or in the direction in which its action should be called into play: thus, upwards when the elevators are paralyzed, downwards when the depressors are involved, and outwards or inwards in the case of the external and internal recti. Certain actions, as climbing or descending a ladder, may thus bring a diplopia into troublesome prominence; on the other hand, a certain position of the head is often assumed by the patient so as to prevent the tendency to diplopia. In testing, therefore, we require to use various positions for the object.

The following points being borne in mind, may help us to understand the variations in diplopia:—When the tendency is to *divergent* squint, the diplopia is "crossed." When the tendency is to *convergent* squint, the diplopia is "direct" (homonymous).

The superior and inferior recti, as already mentioned, tend to draw the eyeball somewhat inwards, when their correctors are paralyzed. The two obliqui tend to evert the eyeball when the counter-balancing muscles are paralyzed.

External Rectus Paralyzed: diplopia is "direct;" images on same level; displacement increased by moving the object outwards.

Internal Rectus Paralyzed: diplopia is "crossed;" images on same level; displacement increased by moving the object towards the sound side.

Superior Rectus Paralyzed: diplopia vertical and "crossed;" image seen by faulty eye above the other, and somewhat obliquely, chiefly when vision is directed upwards.

Inferior Rectus Paralyzed: diplopia vertical and "crossed;" image seen by faulty eye below the other, and somewhat obliquely, chiefly when vision is directed downwards.

Superior Oblique Paralyzed: diplopia vertical and not "crossed;" image seen by faulty eye below the other, and somewhat obliquely, chiefly when vision is directed downwards.

Inferior Oblique Paralyzed: diplopia vertical and not "crossed;" image seen by faulty eye above the other, and somewhat obliquely, chiefly when vision is directed upwards.

The Clinical Significance of Squint and Ocular Paralysis.—When a squint is not of paralytic origin it has not much significance to the physician. Occasionally a squint originates in a paralysis, although this may have passed quite away; in such a case it has some significance in the history. But it must also be remembered that in subjects predisposed to strabismus by optical defects, a concomitant squint may originate in connection with any acute illness quite apart from paralysis.

When a squint is due to paralysis of the third, fourth, or sixth nerves (see pp. 161, 162) it has great significance. As a rule these nerves are affected by lesions at the base of the brain, or the base of the skull, so that some interference with the nerve itself *in its course* is indicated, rather than a lesion at its deep origin; the lesion is thus on the same side as the paralyzed muscle. Hence these nerves are specially involved in cases of cerebral tumor and basal meningitis; they are all very frequently paralyzed from syphilitic disease within the skull. When one of these nerves is involved, the other cranial nerves must also be examined, as combinations of paralysis of the sixth nerve with patches of anæsthesia in the region of the fifth, for example, are even more suggestive of syphilitic lesions. Paralysis of the fourth nerve is usually due to syphilis. Paralysis of these three nerves, however, and especially of the third, may often be classified with the so called "rheumatic" paralyses: that is, they seem to be induced by cold.

Paralysis of the third nerve when complete, includes droop of the upper eyelid (ptosis), paralysis of all the muscles of the eyeball except the external rectus and the superior oblique, dilatation of the pupil, and some defect in the power of accommodation. This paralysis of most of the muscles leads to great deficiency in the mobility of the eye, as already explained, and the pupil is directed outwards and somewhat downwards. The paralysis of the sphincter of the iris should be specially studied in connection with the signs of paralysis of the inferior oblique muscle (occasionally, however, this supply to the iris comes from the sixth nerve.) The dilatation of the pupil in paralysis of the third nerve is moderate: it can be rendered much more extreme by the use of atropine. Extreme dilatation of the pupil, therefore, may indicate some *irritation* of the sympathetic, when there is no question of the use of atropine or belladonna. The various branches of the third nerve may be paralyzed separately, so that we may have ptosis alone, or external deviation alone, or dilatation of the pupil, or various combinations up to the most complete paralysis of the nerve.

Equality or Inequality of the Pupils.—Normally the pupils are equal: they dilate considerably in the dark and contract when exposed to natural or artificial light. Occasionally, however, the pupils are unequal congenitally, and the response to light diminished in the eye whose pupil is already contracted (congenital myosis). In examining such cases we should do so while they are shaded from any bright light. Inequality of the pupils is occasionally found in some persons (congenitally?) along with other indications of an affection of the sympathetic, such as unilateral sweatings. Old iritis sometimes accounts for the contraction and immobility of the pupil observed: this can usually be made out by detecting traces of exudation, or some irregularity in the outline of the iris, especially on dilatation with atropine. As iridectomy is now so common, the student must learn to recognize an artificial pupil. The possibility of an eye wash containing belladonna or atropine being used must never be forgotten in the inquiry: occasionally a little of some belladonna liniment gets into an eye quite accidentally. The action of belladonna in dilating, or of Calabar bean in contracting, an abnormal looking pupil, sometimes affords assistance in the estimation of the abnormality.

Apart from these circumstances, inequality of the pupils is always a fact of great importance as indicating, 1st, (in cases of dilatation), some lesions of the third nerve, the significance of which must be estimated by considering whether the other branches of this nerve are involved. Irritation of the sympathetic (as distinguished from paralysis) may likewise lead to dilatation of the pupil. In cases of this kind we must search for evidence of disturbance of the sympathetic, and see whether the other cranial nerves are affected. 2d, Abnormal contraction, that is, the absence of any considerable dilatation when shaded from the light, may be due to some affection of the sympathetic in the neck, or of the cervical spinal cord (spinal myosis, idiopathic affection or wounds of, or pressure on, the sympathetic in the neck from tumors, especially from aneurisms; and perhaps general paralysis of the insane). 3d, The inequality may be due to some unilateral lesion of the brain, or perhaps to unequal pressure of fluid on the two sides of the brain in cases of injury or effusion. Even when due to serious disease the inequality does not always preserve the same degree, and indeed is not always persistent.

Alterations in the size of both pupils are likewise important. Sometimes they are unduly dilated or contracted, and sometimes they fail to respond to the light in the usual way. Contraction of the pupils may be produced by the use of opium, and this affords a valuable means of diagnosis in cases of suspected opium poisoning, and also in estimating the effect which opium, as a medicine, may have had on the system. Belladonna and atropine, administered internally or absorbed through the skin or mucous surfaces, as well as applied to the eye and brow, produce well-marked dilatation of the pupil: if applied to one eye they act only on one side. Calabar bean, applied to the eye or given internally, causes well-marked contraction. Atropine and Calabar bean seem to have a special and direct stimulating influence on the radiating and circular fibres of the iris, respectively, in addition to any paralyzing effect on the nervous supply. Alcohol and chloroform likewise affect the pupil, but in rather an uncertain way, due in part, perhaps, to their dose, and to their varying effect on the system: other agents also have at times an action on the pupil. In cerebral diseases the pupils are often unduly contracted or dilated, but it is scarcely possible, in the present state of our knowledge, to lay down any general doctrine on the subject. In simple serous effusion, in meningitis with effusion, and in many cases of apoplexy, the pupils are dilated (pressure signs). In not a few cases of apoplexy, however, the pupils are contracted, and this is seen in some of the worst and most rapidly fatal forms of hemorrhage (in the pons). In epileptic fits the pupils are often contracted during the fit and dilated after it. The student must content himself with noting the state of the pupils, reserving the significance of the sign for further consideration and study in view of the whole facts. In cases of total blindness of both eyes the pupils are permanently dilated, unless, indeed there be adhesion of the iris. In uræmic poisoning (renal disease) and in typhus fever, especially in the stage of delirium, the pupils are usually contracted: in enteric fever on the other hand, the pupils are rather dilated. During natural sleep the pupils are contracted: this can often be seen by gently raising the eyelid; the pupil then dilates as the person awakes, and, if the light be bright, contracts again under this stimulus. Under moderate doses of chloral the behavior is the same as in natural sleep.

The sensitiveness of the pupils to light should be tested by first covering the eyes with the eyelids and fingers, and then opening them suddenly; or by keeping the lids open and shading the eyes from the light and suddenly exposing them again; the degree and rapidity of dilatation and contraction may be thus observed. Artificial light from a taper or candle often suits better than daylight, as its direction is more under control. The test is sometimes applied to discover the sensitiveness of the retina in those who are unconscious or unable to express themselves. In such cases we may have contraction of the iris in a blind eye through the influence of light on the other, if it be sensitive, and there may be likewise a sympathetic dilatation: hence it is better to test the eyes separately. The sensitiveness of the pupil to light is often much diminished in apoplexy, and also when there is effusion of any kind on the brain. In some cases of meningitis the pupil is affected by light, but instead of contracting it oscillates, *i. e.*, varies between contraction and dilatation in a curious way. (Tremulousness of the iris itself, backwards and forwards with a wave-like motion, arises from undue fluidity of the vitreous, probably combined with rupture of some portion of the ligament of the lens, and is only of ophthalmic interest.) When one or both pupils are much dilated or contracted from the influence of drugs, or from paralysis, or from congenital peculiarity, they are not readily affected by light.

Convulsive movements of the occular and palpebral muscles exist as independent functional affections of the eye; they then come more properly under the notice of ophthalmic surgeons, but they sometimes serve to indicate cerebral mischief. Spasm of the orbicularis palpebrarum (blepharospasm) occurs in cases of intolerance of light, and also from other forms of reflex irritation, but twitchings and remittent spasm of this muscle may, if severe, be due to more general and central causes, resembling thus certain forms of wry-neck, twitchings of the trapezius, &c.

Nystagmus (convulsive rhythmical movement of the eyeball) occurring as an independent affection, and dating from early life, need not be noticed here. Nystagmus seems also to be developed in connection with particular occupations, as in coal miners and some others. It is also, however, met with as a symptom of a definite and localized disease of the nervous centres; it sometimes appears in one eye only, but usually in both. The movements can often be seen at the beginning of fits, and are then regarded as part of the convulsion. Sometimes, however, they are associated with a peculiar deviation of the eyes, both eyes being directed as if the patient were trying to look fixedly towards the back of his shoulder (conjugate or lateral deviation of the eyes); associated with this there is often, if not usually, a turning of the head also in the same direction. This group of symptoms seems to be associated with disease affecting the crura cerebri, and the head and eyes are turned to the side on which the disease exists in the brain, viz., away from the paralyzed limbs in cases in which paralysis exists.

The acuteness of vision affords indications as to the state of the optic nerve, but of course the vision may be interfered with by many local causes which have no special significance to the physician (opacity of the media, closed pupil, &c.); moreover, the advance of age lessens and abolishes the power of accommodation (presbyopia), and there may also be a paralysis of the accommodation from nervous lesions or the action of drugs. Optical defects (hypermetropia, myopia, and astigmatism) often produce imperfect vision, and so may simulate an impairment of the optic nerve. These subjects must be studied in detail at the eye infirmaries, but with a few precautions the use of Snellen's test-types[1] affords a valuable means of testing the vision: the different numbers of his scale can be read fluently by an average eye at the corresponding number of feet[2] (No. $1\frac{1}{2}$ at a foot and half, No. 20 at 20 feet, &c.); lines and spots are given which may be counted by those who are unable to spell the Roman capitals. In using the types both high and low numbers should be used at corresponding distances. The difference between the nearest and furthest points at which the smaller types can be read indicates the range of the accommodation; but a full examination demands in certain cases the use of lenses also.

The degree of hypermetropia is estimated by the *strongest* convex glass with which the person can read No. 20 at 20 feet, or the corresponding types at 6 metres: this represents the "manifest hypermetropia." But when the accommodation is completely paralyzed by the repeated application of atropine, a further strength of convex lens may be required, this addition being the index of the "latent hypermetropia." In the case of myopia the *weakest* concave glass sufficient to render No. 20 visible at 20 feet (or at 6 metres) is reckoned the measure of the myopia. When such lenses improve the vision without rendering it perfect, astigmatism should be tested for: some circular arrangement may be used, such as the dial of a clock, to see if all the figures on the circle and the hands in the various positions are perfectly straight and equally distinct. When by suitable glasses the person can read No. 20 at 20 feet (or at 6 metres in the other scale), we reckon the vision good, the presumption being that any defects are merely due to optical causes. In many such cases, however, the correction is not absolutely satisfactory, especially in myopia.

It must be remembered that there may be a marked affection of the optic nerve although the person may be able to read the smallest types quite satisfactorily.

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[1] Test-Types for the Determination of the Acuteness of Vision, by H. Snellen, M.D., Fourth Edition. Williams & Norgate, 1868. Also, Optotypi ad Visum Determinandum. Editio Quinta. Metrico Systemate. 1875.

[2] Parisian feet which are slightly longer than English; proportion, 46—49.

In the fifth edition the metrical system is followed, beginning at 0.5, 0.6, and so on in fractions of a metre.

The field of vision should be estimated in certain cases, as it is often of great importance in medical practice: it is found to be much diminished in some affections of the optic nerve, due to cerebral as well as to more local causes. Each eye should be tested separately: the line of vision of the patient is to be directed steadily forwards, say to the nose of the observer seated immediately opposite him, and the observer's finger or some luminous object in his hand should then be carried to the extreme left and right, and above and below, till the limit is reached at which it is still visible while the eye is kept looking straight forward. Ophthalmic surgeons have more accurate methods of measuring and reducing to a scale the field of vision, but this method is a ready means of forming a fair general estimate. The field of vision is sometimes contracted almost equally in all directions, but the defect is usually in particular directions, such, for example, as the upper and inner half. When the defect is strictly defined as being to one half, usually a lateral half, the affection is named Hemiopia (see p. 156). Local defects in the field of vision may be detected in connection with localized lesions of the retina.

Ophthalmoscopic examination of the eye is useful (1) in discovering whether the loss of vision, which may be detected, is due to other than nervous lesions; (2) in distinguishing various affections of the retina and optic nerve from each other; and further, (3) marked changes of much diagnostic significance are sometimes discovered when there is no affection of the vision as tested by types. The use of the ophthalmoscope must be learned practically in the dark rooms of our eye infirmaries, and no description of the instruments or the methods of using them would be here of much use. The methods by the erect and inverted images are both used for medical cases, but for the more delicate examination of the nervous and vascular changes the direct method is preferable. The student should aim at making himself familiar with both methods, and should, by examining many eyes, apart from any cerebral affections, learn to distinguish the varieties in the size, shape, and appearance presented by the optic nerve, whether congenital or acquired, and in particular the changes in the fundus so often associated with hypermetropia and myopia. He should also learn, if possible, to estimate the degree of hypermetropia or myopia by means of the opthalmoscope, as in many cases in *medical* practice no other method is available.

The following are the points specially to be attended to in using the ophthalmoscope in medical cases: *The shape of the optic disc* should be noted; if both discs are oval in the same direction, instead of being circular, optical defects (astigmatism) should be tested for, before concluding that there is a real change. *The course of the bloodvessels over the disc* must be scrutinized; in particular let it be noted whether the arteries appear to project forward on the disc, or to curve over its edge from its swollen state (choked disc, œdematous papilla). *The size and appearance of the large arteries* should be described, as to whether they seem diminished in calibre, and whether they appear glistening and as if affected with sclerosis, or accompanied with whitish streaks. These streaks are found associated both with intra-ocular and with cerebral disturbances: in the former (hypermetropia) the acuteness of vision is not diminished, but in cerebral cases giving rise to this condition of the arteries, the vision is almost always affected; streaks over the centre of the vessels do not indicate serious changes, and are due probably to mere reflection of the light. The vessels may be abolished by an *embolism* of the retinal artery or of one of its branches; this accident is characterized by sudden blindness; at first there is a whitish patch of exudation with a red spot, marking the position of the macula; this exudation disappears, and the color returns in a few days, but the vessels soon become obliterated, and the blindness is permanent. *The veins* should be noted as to the presence of enlargement or tortuosity, and as to whether they seem specially dark and congested where they dip into the tissue of the nerve. *The size and color of the disc* are very important: attention must be directed to see if it is unduly pale or of a bluish or greenish tinge, and the distribution of pigment around its margin, if any be present, must be noted. The disc is often pinker than normal, shading off so gradually into the color of the retina as scarcely to be distinguished from it (neuritis). Or the disc may be unduly pale, with a deficiency of the minute vessels distributed to its substance (white atrophy, sclerosis). The disc itself may be normal or pale, even although the large vessels in front of it are increased in number. The size of the disc may remain normal, although the condition known as white atrophy is highly marked, but the nerve may be shrunken as a whole or in particular parts (atrophy with loss of substance, or contraction). *Traces of exudation*, either in patches or in the course of the vessels, are sometimes found associated with a general pink and prominent aspect of the disc, which assumes a woolly appearance ("choked disc"). The bloodvessels should also be examined in their course, particularly as to the *presence of hemorrhages:* these should be noted as to whether they seem true clots, or whether the vessels seem to terminate in branching-like spots involved in patches of white exudation. When reddish spots without any true clot are found, miliary aneurisms may sometimes be suspected. *Large exudations* forming irregular patches, partly on the nerve and partly beyond it, or connected by streaks with the disc, obscuring the vessels and associated with loss of vision, are to be suspected as syphilitic. *Whitish pearly spots of exudation* in the neighborhood of the macula lutea are common in Bright's disease of the kidney, and larger patches, with smaller glittering spots elsewhere, are also found in this affection; somewhat similar patches are seen occasionally in diabetes. *Shining miliary tubercles* are occasionally seen in the choroid in cases of tuberculosis and tubercular meningitis.

Significance of Ophthalmoscopic Appearances in Medical Diagnois.—Optic neuritis and optic atrophy are the two most important conditions discovered in the fundus in the examination of medical cases. Atrophy is often preceded by optic neuritis in cerebral tumors and inflammations, and in such cases the disc is usually ragged or ill-defined at certain parts; in simple white atrophy, on the other hand, the disc is sharply defined, but this form of atrophy is less characteristic of definite cerebral affections, being found in a variety of conditions. Great changes in the fundus are observed from time to time in the progress of cerebral cases involving the optic nerve and retina; hemorrhages appear and disappear, or give place to patches of exudation. These sometimes become absorbed, or they may increase in number and size. The tendency is for all these inflammatory processes, including even œdema of the papilla, to terminate in atrophy of the nerve.

In attempting to explain the changes in the fundus of the eye, as bearing on medical diagnosis, we must be content with comparatively obscure indications, as the subject has not been sufficiently long under competent observation to lay down general laws safely. The exudations described as characteristic of syphilis, or of Bright's disease, and miliary tubercles, aneurisms, or embolisms (when they can be recognized as such) are sufficiently suggestive of their significance. In addition to the exudations already described, hemorrhagic spots are likewise found in Bright's disease (as well as in cerebral cases), and the detection of such always demands an examination of the urine; not unfrequently cases of Bright's disease come first under notice from a failure of vision due to these changes. Œdema of the retina likewise occurs in renal dropsy, and its aggravation or subsidence may account for the great changes in the state of the vision which sometimes occur within short intervals. In endeavoring to understand the ophthalmoscopic appearances found in connection with cerebral tumors and inflammations, the following different theories may be borne in mind, as they have been advanced to explain the swollen and inflamed state of the optic nerve known as the "choked disc." 1. An interruption to the return of the blood from the eye, due to pressure on the cerebral veins by a tumor, may give rise to congestion and slight fulness of the optic nerve, and there may then be induced a *secondary* increase of this congestion, from strangulation, as it were, of the vessels of the congested and swollen nerve, by its own inexpansible sheath. 2. Or, the swelling congestion, and œdema of the disc may arise from pressure in the sub-vaginal space, either from the presence of exudation originating there, or from the pressure of fluid forced along the sheath of the optic nerve from the sub-arachnoid space. 3. An extension of the inflammatory process from the brain or cerebellum, or the membranes, down the course of the optic nerve, may give rise to a "neuritis descendens." 4. Vascular changes, resulting in congestion of the optic disc, may be due to disturbances of the circulation, brought about through an indirect influence of the cerebral tumor, or other mischief, on the vaso-motor or sympathetic system, apart from any merely mechanical effect, or from any continuity of inflamed tissues.

Optic neuritis or atrophy due to cerebral causes is usually double, although the changes in one eye are often more advanced than in the other; if only one eye be affected, a lesion on the opposite side of the brain may be presumed. Localization of the disease from ophthalmoscopic signs is scarcely possible, but the comparative frequency of blindness and affections of the optic nerve in tumors of the cerebellum is well established. Unilateral optic atrophy (white) is not unfrequent in locomotor-ataxy.

THE EAR.

The sense of hearing is usually tested by means of a watch applied to or held near the ear. We begin by applying the watch closely enough for it to be distinctly heard, and we gradually remove it, in a straight line from the ear, till the sound is lost, and by measuring this distance we have a means of comparison between the two ears, and also a rough gauge of the absolute acuteness of hearing. In other cases, low speech, or notes of different pitch, at varying distances, or loud sounds, are sometimes tried to test the power of hearing. Some persons hear a watch badly, and conversation pretty well; in others, again, this is reversed. A large vibrating tuning fork (C) applied to the forehead, to the vertex, or to the front teeth of the upper or lower jaw, likewise affords valuable assistance, especially in discriminating deafness due to nervous causes from that which results from disorders of the channels and the mechanism of the ear. When the sound of a tuning fork (or a watch) thus applied, is perceived by the patient principally or exclusively on the side on which he is deaf, aurists conclude that the difficulty of hearing has a peripheral cause, and is due to some impediment to the conduction of sound: in the opposite case a lesion of the labyrinth, or one inside the cranial cavity, may be inferred with great probability. If we close the external meatus on one side, and apply a vibrating tuning fork to the vertex, and if we find the sound much the same on both sides, or less where the meatus is closed, there is a probability of some lesion of the nervous part of the auditory organs on that side.

When by means of the watch test, or otherwise, we are satisfied of an impaired state of the hearing, we must examine the organs to see if any impediment can be found, such as a plug of wax, or any growth or tumor in the meatus, or any obstruction in the passage of the Eustachian tubes. The ear is illuminated by reflecting light from a concave mirror through a speculum which straightens and slightly dilates the external meatus. Daylight is much the best, but a lamp may be required when this is defective. If wax be found on such an examination, the hearing should be tested after its removal by syringing, as it does not follow that the wax was the sole or the chief cause of the deafness complained of. Inquiry should likewise be made as to the existence, at any period, of discharges of any kind from the ears (pus, blood, or watery fluid), and in such cases the likelihood of perforation, or even of almost complete destruction of the membrana tympani, must be considered. Fracture of the base of the skull must also be remembered in this connection. This perforation may demand a careful examination of the ear by means of the speculum, as just described, but sometimes it can be demonstrated by causing the patient to force air into his ear by blowing his nose while the nostrils are tightly compressed (Valsalva's method). In many cases of perforation of the membrane, we may, in this way, hear the air rushing through the meatus. This same experiment likewise enables us to discover if the Eustachian tube is patent; for when the tympanum is in its natural state we may thus hear, by means of the aurist's diagnostic tube (or even a stethoscope applied to the external ear), a sharp click from the compression of the air in the cavity during the blowing of the nose as described. This method is not available in children, or in those adults who cannot be made to do the experiment properly. Pollitzer's bag, with its tube introduced into the nostril, is often useful in such cases, as the air can frequently be thus blown into the Eustachian tube during the act of swallowing; in children, swallowing is not required for the success of this experiment. In other cases, again, the proper investigation requires the air to be actually blown into the Eustachian tube by an instrument introduced into it, but such manipulations are only to be attempted by those specially trained in aural surgery. In examining the Eustachian tubes attention should be directed to the condition of the pharynx, tonsils, and posterior nares, as many aural diseases begin in this situation. A proper examination of this region and of the orifices of the Eustachian tubes may demand the use of Rhinoscopy.—(See Chapter x.) In the examination by the speculum and reflected light, we aim at discovering the condition of the walls of the meatus, the appearance of the membrana tympani, whether it is ruptured, or whether distinct variations exist in the curvature of the membrane—such as bulging towards the meatus or the contrary—whether there is any abnormality in the reflection of the light from the membrane, and whether there is undue vascularity in the neighborhood of the handle of the malleus or elsewhere, and even an exploration of the state of the petrous bone, in cases of suppuration, can sometimes be made, although the probe is a dangerous instrument in such situations. All these changes point to disease of the meatus and middle ear, and they indicate mechanical causes for the deafness, and so may remove it from the realm of the physician. But suppuration in the tympanum, &c., may throw a light of the utmost value on certain cerebral or pyæmic symptoms in a case. Abscess of the brain and meningitis occasionally depend on some previous suppuration in the ear, and this may have extended upwards from the throat, as in certain cases of scarlatina. Puffiness over the mastoid process, with or without present or past otorrhœa, is frequently found in connection with suppuration going on in the mastoid cells, and this suppuration may be associated with a train of symptoms indicative of septic poisoning or other serious mischief, to which it may supply the only clue. When a degree of deafness exists, and its cause cannot be referred to any impediment in the passages of the ear, we may infer a lesion of the auditory nerve in some part of its course, and an examination of the other cranial nerves may throw some light on the nature and position of the lesion; the presence of subjective symptoms must likewise be considered in this connection (see p. 158). The occupation of the patient, and his relation in this respect to noises, the previous history of blows on the head, of attacks of giddiness, or of noises in the ears, and the family history as to deafness, hereditary syphilis, &c., should all be inquired into. Scarlatina and typhus fever are often complicated with deafness during the acute illness, and occasionally as a sequela; in the former disease the mischief is usually in the mechanism of the ear, in the latter the deafness is almost always nervous.

THE NOSE.

The sense of smell is tested by applying a phial charged with very distinct odors to the nostril: one nostril should be tested at a time, the other being compressed, and the mouth also should be kept shut. If the smell be not appreciated in this way, the mouth may be kept open while the scent is being sniffed up, or strongly flavored materials may be given to be tasted or applied in such a way as to allow the odor to ascend by the posterior nares. The odor may be blown into the mouth and the person directed to breathe out through his nose. The patient may likewise be questioned regarding his recognition of flavors in his food or drink, as it has been clearly ascertained that much of what we discern by the mouth is really due to the sense of smell, and that those who are affected simply with a loss of smell from nervous lesion (anosmia), are incapable of discriminating the flavor of many articles of diet (wines, coffee, cheese): such persons frequently tell us that both smell and taste are nearly gone.

Certain fallacies beset our investigation of this sense. 1. Strongly pungent vapors or solids (ammonia, snuff, &c.) may be recognized by those destitute of smell, from the action of these irritants on the branches of the fifth nerve: such things, therefore, must be avoided as tests: assafœtida, musk, essence of lemon, &c., are suitable for this purpose. 2. Smell may seem lost from some imperfection in the nasal cavity apart from any nervous lesion: thickening of the mucous membrane from a common cold, or more serious alterations in the hard or soft parts, as well as distinct growths, are frequent sources of imperfection in the sense of smell: in such cases smells may possibly still be appreciated (especially as flavors) by way of the posterior nares. 3. In facial paralysis, probably from some difficulty in directing the odorous current properly to the olfactory tract, in sniffing it up, there is sometimes an imperfect sense of smell in the paralyzed nostril, without any real defect in the first nerve. A dryness of the nostril may likewise cause a defect in smell,—the tears flowing down the cheek instead of into the nasal duct in certain cases of facial paralysis.

Loss of smell, as a single lesion, is sometimes met with in connection with injuries to the head: but in the case of cerebral tumors and the like, other nerves are usually involved and not the first nerve alone.

"Running from the nose" is one of the symptoms found during the invasion of measles. Chronic discharge from the nose is sometimes simply catarrhal, but it is usually fetid (ozœna), and often depends on disease of the bones which can be detected by the probe. Such a discharge, in children, from one nostril only, is always suggestive of the presence of a foreign body in the nose. Fetor from the nose may be distinguished from fetor due to gangrene of lung, or from that of sore throat, disordered stomach, carious teeth, &c., by testing the breath while the mouth and the nostrils are closed alternately. The obstruction to the breathing through the nose observed in infancy, and known as "snuffles," is usually due to syphilis.

THE SENSE OF TASTE.

The sense of taste is not easily tested in a satisfactory manner. The difficulties are the following. Some so-called tastes are really appreciated by the olfactory nerve, while acrid substances may, perhaps, be recognized by the nerves of common sensation. Loss of taste from nervous causes (ageustia) is usually unilateral, and when a sapid substance is applied to one side of the tongue as a test, it is apt to pass over quickly to the other side, or to the soft palate, when the tongue is taken in. To avoid this, the substance may be applied to the tongue while it is kept protruded, but it is found that even in the normal state it is not easy to recognize various tastes under such conditions. The sense of taste proper seems to reside in the tongue and soft palate chiefly, but the movements of the tongue against the hard palate and lips, and the intimate admixture of the substance with the secretions of the mouth, seem to be almost essential for the proper appreciation of tastes. A further difficulty arises from the different parts of the tongue having very different degrees, and even kinds, of sensation. The best way is to try strong solutions of a sweet and of a bitter substance, as these are pure sapids (sugar and picric acid, *e. g.*), and to rub them with the finger or with a brush, *very freely and firmly* on to various parts of one side of the tongue while it is protruded, and to ask the patient to indicate by a movement of the head whether, and when, he recognizes the taste before he takes in his tongue. If we suspect a defect on one side we can sometimes demonstrate it more clearly by applying the test solution to the affected side, and while it is still unrecognized we may touch the other side of the tongue with the same substance before it is taken in; we may thus find that the patient at once indicates his recognition of the test fluid on the sound side by a sign or a contortion of his face. Care must be taken to have the patient's mouth thoroughly washed out before any new substance is tried, as also to have the brushes or other agents used in applying the test thoroughly cleansed, and it is well to begin with the milder tastes, as the strong bitter substances linger a long time in the mouth and complicate further trials. In addition to sweet and bitter, acid and salt substances may be tried, but it is not quite so certain that these are recognized purely by the special sense of taste, as distinguished from that of common sensation. Acids without smell must be selected for such trials. Along with the test by sapids, the tongue should also be tried as to its tactile sense by the compasses (see pp. 150, 151); loss of taste with perfect tactile sensation, and loss of tactile sense with perfect taste, are both occasionally found, as well as loss of both; we must also, of course, pursue the examination by testing the other cranial nerves, &c. The significance of a lesion of taste, when ascertained, is rendered somewhat obscure by the curious differences of opinion as to the nerves of taste and their real origin. The glosso-pharyngeal, for special sense at the back part of the tongue, is generally recognized by all. The lingual branch of the fifth nerve is admitted by all to supply common sensation to the tongue, and most authorities consider it to be concerned more or less also in the special gustatory sense: the chorda tympani nerve, however, which joins it from the seventh, is regarded by many as the nerve of special sense for the anterior part of the tongue, and it seems quite certain that it has something to do, in some way, with the sense of taste: but admitting this as proved, it is not quite certain that the portio dura of the seventh nerve, in itself, really contains sensory fibres; some, indeed, allege that the sensory fibres in the chordo tympani come from the "pars intermedia of the seventh pair or from some junction with the fifth nerve in ways which are not always uniform. It is conceivable, moreover, that a nerve may affect the sense of taste by an indirect action on the glands and papillæ, apart from any sensory function. What is certain is that taste may be affected in cases presenting evidence of a lesion in the glosso-pharyngeal nerve; that it may be affected, or preserved, in cases presenting definite lesions of the fifth nerve, including among these anæsthesia of the tongue; and that it is sometimes affected in cases presenting the well-known features of paralysis of the portio dura of the seventh pair, arising from disease of the ear and other peripheral causes. The variation as to the presence of the affection of taste in this facial paralysis depends probably on the exact locality at which the lesion of the seventh nerve exists; when this paralysis is due to a cerebral lesion, the taste does not appear to be affected.

The taste may also be affected in various ways in general diseases, such as insanity and hysteria; and from more local causes affecting the tongue, such as dryness in febrile disease, foul coating in dyspepsia, stomatitis, and the like.

COMMON SENSATION.

The tactile sense is very unequally distributed over the cutaneous and mucous surfaces, some parts being very much more sensitive than others. Defects in the acuteness of this sense are often complained of in particular parts, and so it becomes important not only to verify the existence of this anæsthesia, but also to define with some accuracy its degree and its distribution. Various methods are pursued. The patient may be touched lightly with the finger in various parts, the observation being of course varied with blank experiments, and he should be asked, while his eyes are shut, whether and at what part he is touched. It is found that in anæsthesia the precision of localizing the sense of impact is much diminished. If the defect be very slight the patient may be tried with the most delicate impressions possible, such as result from the touching of a hair; if, on the other hand, the sense be very dull, the point of a pin, or the pinching of the skin, may be used to produce a distinct impression, and by the patient's answers, or the expression of his face, we may be able to define the area of impaired sensation. In conducting such experiments it should be noticed if the perception of the impact is distinctly delayed, as this indicates a bluntness in the sense. Other methods of testing the sensation consist in trying if the patient can recognize by the hand, and with his eyes shut, different textures of cloth, flannel from cotton for example, or if he can say whether a carpet, or a rough or a smooth substance, is interposed between his bare foot and the floor, care being taken that there is no great difference in the temperature of these objects. The lifting of minute objects by the hand, the discrimination of coins—such as a threepenny-piece from a fourpenny-piece,[1]—and the manipulation of worsted or cotton yarn in sewing or knitting, often enable us to judge of the degree of tactile sense remaining with considerable certainty; blindfolding the patients often brings out very prominently the loss of tactile sense, as we may find them groping about with their hands for objects which are already actually touching their fingers. These methods, or at least some of them, are applicable to various ages and various grades of intelligence, but a greater precision is sometimes obtainable by means of the compasses (Weber's test). Considerable intelligence is

[1] From the presence of a milled edge.

required to secure reliable results by this process, and the patients often seem so stupid or careless, or fatigued, as to render the results a mass of confusion. The essence of the test consists in discovering the smallest distance at which the two points of a pair of compasses, simultaneously and lightly applied to the surface, can be recognized by the touch as two separate objects. The points should be blunted in some way (except, perhaps, in the case of the finger tips and other sensitive parts); cork or sealing wax serves this purpose, or the points themselves may be rubbed down. The patient should first be informed, with his eyes open, as to the process of testing to be attempted, a few trials being made to let him know the object aimed at. The eyes should then be shut, or the vision obstructed in some way, and the compass, widely opened, applied so as to give a distinct impression of two separate points; the points should then be gradually approximated till they are felt as if they made only one impact, or till the answers become confused and unreliable, in which case we may revert after a time to the same part to see if the same result is obtained. During this gradual approximation of the points of the compasses, an occasional variation by the impact of only one limb of the compasses, should be introduced so as to make sure that the patient is not answering at random.

The following directions should be attended to: 1. The two points must be put down simultaneously, otherwise the succession of the impacts leads of itself to the inference of two points. 2. The part of the patient under observation should be kept quite unmoved and steady; patients instinctively, while in doubt, tend to move the fingers or hand to satisfy themselves whether two points are applied, as they get in this way also a succession of impressions. 3. The two points should be always kept in the same relative direction in making estimates of the delicacy of sensation in the same limb, *i. e.*, we must keep always either in the axis of the limb or always transversely to it.

The following list may serve as an indication of the normal sensitiveness of different parts, but it cannot be regarded as absolute; a comparison of the sensation on the two sides of the body indicates changes in a more reliable manner when the lesion is unilateral. (Selected from Weber's table.)

Point of the tongue	½ line	Red surface of lips	2 lines
Dorsum and edge of tongue	4 lines	Lips where covered with skin	4 "
Palmar surface of 3d phalanx	1 "	Dorsal surface of 3d phalanx	3 "
Palmar surface of 2d phalanx	2 "	Dorsal surface of 1st phalanx	7 "
Palmar surface of metacarpus	3 "	Dorsum of hand at knuckles	8 "
Skin of cheek	3 "	Middle of thigh	30 "
Tip of the nose	3 "	Over patella	16 "
Lower part of forehead	10 "	Dorsum of foot near toes	18 "
Neck under jaw	15 "	Penis	18 "
Skin beneath occiput	24 "	Upper dorsal vertebræ	24 "
Sternum	20 "	Middle dorsal vertebræ	30 "

The area of diminished sensation, or of complete anæsthesia, often enables us to refer the defect to a single nerve, or to a special branch of a nerve. The extent of the area of anæsthesia, and its level in the trunk, may enable us to define the locality of the lesion in the spinal cord to which it is due. Anæsthesia is, indeed, very often due to spinal lesions, but is sometimes found in more general diseases, after diphtheria for example, in hysteria, and occasionally in other affections clearly of a functional character. (See Electrical Tests for Anæsthesia, Chapter vii.) In cases of ovarian irritation certain limited areas of anæsthesia can sometimes be made out; occasionally the anæsthesia in such cases only extends to one side of the body (hemi-anæsthesia); such unilateral anæsthesia is found also in some cases of cerebral disease (posterior part of internal capsule), associated with paralysis of the same parts. In locomotor ataxy anæsthesia of the feet and legs is very common. (Compare section on Paralysis with Anæsthesia, p. 168.) Anæsthesia is frequently caused by pressure on the nerves, as by tight bandages, splints, crutches, &c., or by more serious forms of pressure arising from malignant tumors, aneurisms, abscesses, &c.

The trophic effects of nervous lesions must be noted, when present, as important facts in cases of anæsthesia; ulcerations of the cornea in the case of the fifth, glazing of the skin, grayness of the hair, and the like, are to be named in this connection. Anæsthesia can occasionally be shown to exist in an area affected with neuralgia, and a certain degree of anæsthesia—a dulled perception of tactile impressions—is habitually present in cases of so-called hyperæsthesia in which slight irritations of the skin produce painful impressions.

Dulness as regards tactile impressions is to be distinguished from dulness to painful sensations. (Analgesia.)

Diminished sensitiveness of the fauces, epiglottis, &c., sometimes determines the occurrence of choking or of pulmonary affections, especially in the insane.

The sense of temperature is probably a form of common sensation, but it is found to be preserved in certain cases in which the tactile sense is diminished (locomotor ataxy, *e. g.*). It may be tested by applying sponges dipped in water of varying temperatures, and ascertaining if the patient can appreciate the changes from one temperature to another. A hot sponge applied to the back is sometimes felt to be acutely painful, but this is rather a form of spinal tenderness than of change in the cutaneous sensibility.

THE MUSCULAR SENSE.

The " muscular sense" is a name applied by some to the faculty we possess of judging of weight. This faculty is often very defective in locomotor ataxy, and has been supposed to account for the incoordination of the movements found in this disease. In the case of the upper limbs various weights, of as nearly as possible the same bulk, may be given as tests while the patient's eyes are closed, and it can then be seen how far he is able to discriminate them by his muscular sense. For light objects coins answer admirably —half a sovereign and a sixpence, for example. In testing the lower limbs the patient may be placed on a high seat, with his feet quite off the ground, or one leg may be swung over the other, and various weights, enclosed in a bag or attached by any other convenient arrangement, may be suspended on the foot, and the power he has of estimating weights may thus be gauged.

SUBJECTIVE DISORDERS OF SPECIAL SENSES.

In the preceding sections derangements in the organs ot sense have been considered from the objective point of view —*i. e.*, the discovery of an obvious change, or at least the clear demonstration, by a reliable test, of some actual disease. Our attention, indeed, is usually directed to some of these by the complaints of the patients themselves, but many abnormal sensations are spoken of by them which we must accept for what they are worth, simply and absolutely on their own statements.

are often complained of in this way. *Polyopia Monocularis*, or manifold vision with a single eye, is comparatively rare, and is always due to some error in the eyeball itself. Irregularities of the crystalline lens or cornea, and the presence of artificial pupils, are the recognized causes of this affection, so that it has no significance in medical diagnosis.

Diplopia (double vision when both eyes are open) is due to paralysis or to a want of proper balance in the muscular adjustments of the eye. This kind of diplopia is associated with a tendency to squinting, even although no actual squint may be detected; indeed, when squinting is fully established, diplopia usually ceases. Diplopia is sometimes complained of by adults at the beginning of meningitis (probably from a slight paralysis), but is likewise produced in some persons by less serious disturbances; derangement of the digestive organs, for example, may bring it on. In certain cases of drunkenness there is a want of co-ordination of the ocular muscles, producing double vision; a similar condition is found in the early stages of locomotor ataxy, without any permanent squint, as well as in the later stages, when a true paralysis of the ocular muscles may supervene. Even when due to disturbance of the cerebral functions, diplopia, like strabismus, is particularly apt to occur in those whose eyes are not normal as regards refraction. For details, and also regarding *obliquity in the objects looked at*—see pp. 129 and 133.

An erroneous estimate of the position of objects is common in cases of paralysis of the ocular muscles, so that a person whose right external rectus is affected, when asked to strike an object placed on his right, is often found to make a mistake; this probably arises from the mind being conscious of an unduly great energy being directed to the paralyzed muscle; it appears probable that the position of objects is estimated from this "outgoing current," as it is termed. This erroneous estimate of the position of objects in certain directions leads to constant confusion from the changes which occur in the position of objects as the person walks along or even moves his eyes; hence arises the "monocular vertigo" which occurs in cases of paralysis of the third nerve, for example, if the sound eye be closed and the drooping lid held up as the patient walks along. A somewhat analogous confusion and vertigo may result from binocular diplopia, or from conditions bordering on this state. An erroneous estimate of the position of objects, or of the position of the false image in diplopia, from an apparent forward displacement, is found to occur in certain cases of ocular paralysis, particularly when the fourth nerve, and the superior oblique muscle are involved.

The accommodation of the eyes for distinct vision of near objects becomes defective with age (about fifty years of age); this "presbyopia," as it is called, is probably due, in part at least, to changes in the lens itself; such defects become more pronounced and occur at an earlier age in those who are hypermetropic, and so require to use their accommodation even for distant vision. The accommodation may be defective from some nervous lesions, as when the third nerve is paralyzed, and diphtheritic paralysis of the accommodation is not uncommon. The size of the pupil is not always affected when the accommodation is paralyzed, although both are very often involved together. When the vision is defective from this cause convex glasses (+ 12) should correct it fully. (Atropine, it must be remembered, paralyzes the accommodation *pro tempore.*)

Strain on the eyes, a sense of fatigue readily induced, and a great tendency to confusion of the lines and words in a book, after reading for a few minutes, constitute the indications of "asthenopia." This strain may be prolonged or intensified to such an extent as to give rise to headache of such a character as to suggest cerebral mischief. This excessive strain may be due to some specially exacting form of work arising in connection with the constant and extreme demands made on the power of the accommodation or of the convergence; sometimes, indeed, the combination of different and unnatural degrees of accommodation and convergence may produce this strain, particularly in those who use glasses. These excessive demands arise in connection with optical defects of the eye—hypermetropia, myopia, and astigmatism—in the last the varying demands are incessant and most exacting. The headaches arising from the strain thus produced, although at first induced directly by taxing the eyes, may continue in a more permanent form, so as to give little or no suggestion of an ocular origin of the disorder. Some of the defects cause a constant strain on the eyes, which cannot be relieved by any amount of apparent rest.

Muscæ or motes are to be distinguished according as they are fixed or floating. Muscæ volitantes—motes flying about in the field of vision—may be seen by any healthy eye, and in such cases they are due to minute opacities normally existing in the vitreous. They may be demonstrated by looking at a light through a minute hole in a blackened card; in this way the eye is thrown out of focus, and the shadows are projected on the retina. Motes like the strings thus seen, and also motes darting in various directions, may be seen at times apart from disease, especially on looking at dazzling white objects; they are often rendered more obtrusive in myopic eyes, and in conditions of weakness and irritability of the retina from whatever cause. Motes from these normal opacities must be distinguished from floating specks due to abnormal opacities in the vitreous; the latter are generally visible with the ophthalmoscope. Fixed muscæ—fixed black spots or bands—are due to opacities in the substance of the retina. Opacities in the lens are revealed by ophthalmoscopic illumination as black bands or streaks, but they are not perceived by the patient as such, unless the eye be thrown out of focus as by the experiment with the blackened card, just described, or in some similar manner.

Hemiopia.—When the patient complains that he sees only one-half of an object, this is due to a defect in one (lateral) half of the field of vision, *i. e.*, to defect of the retina on the half opposite the unseen or blank part. It is always an affection of the optic nerve, and its accurate limitation to one-half of the field of vision is, no doubt, related in some way to the decussation of the fibres of the optic nerve at the commissure, or the division of its root at the thalamus, but the exact nature of this affection remains still uncertain. Hemiopia is met with occasionally in cerebral tumors and similar lesions; it usually affects both eyes; the commonest combination is to have the nasal side of one eye and the temporal of the other affected. Hemiopia is sometimes combined with hemi-anæsthesia, the person is blind on the side with which he would otherwise look on his affected limbs. If the two inner sides be involved, the hemiopia is, of course, less marked: it is seldom that an upper or an under half is involved. One eye is sometimes affected alone.

Flashes of light (photopsia) are produced by irritation ot the retina, or of the optic nerve in any part of its course from the brain. Even gentle pressure on the eyeball gives rise to circles or flashes of light, and blows produce more violent flashes in the same way; such sensations are frequent in incipient disease of the optic nerve. Flashes of light are likewise often complained of by those whose cerebral arteries are rigid, and in whom disturbances of the circulation in the optic nerve, or in the cerebral centres connected with it, may be presumed to exist; they are recognized as amongst the prodromata of apoplectic and other cerebral seizures.

Colored spectra (chromopsia) are of somewhat similar nature; they have been known to usher in epileptic fits. *Yellow vision* (xanthopsia) is observed in certain cases of jaundice, but it is rare, at least in a highly marked form; it is occasionally produced by santonine administered internally; this predominance of yellow renders the recognition of red difficult.

Color-blindness is not uncommon as a congenital or even as an hereditary defect. Red and its compounds are the colors most commonly affected. No special significance can be at present attached to this congenital defect. A degree of color-blindness, however, is often found in connection with blind spots in the central part of the retina, and in this way it has a place as one of the symptoms of optic atrophy. In testing for color-blindness, samples of colored paper or wool may be given to the patient to be compared or matched.

Hemeralopia, called also "night blindness," consists in the inability to see properly towards evening, as the daylight declines. It is found in soldiers and others who have been exposed to dazzling lights. It has no special significance to the physician. This symptom is found also in the affection known as retinitis pigmentosa.

Photophobia, or intolerance of light, is common to many diseases of the eye (keratitis, iritis, and retinitis). It is also found in certain stages of meningitis, cerebral tumors, typhus, measles, &c. In nervous subjects it may exist apart from any serious changes in the eyeball, constituting a hyperæsthesia of the retina.

Dimness of vision (amblyopia) and blindness are due to many causes, coming for the most part within the realm of the oculist alone, and these need not be referred to here, but when associated with evidence of cerebral or renal affections, dimness of vision has, of course, special interest to the physician. It is also one of the symptoms of a general weakness—the muscular weakness affecting either the accommodation or the convergence of the eyes. Anæmia, in like manner, may affect the retina; thus loss of blood, flooding, prolonged discharges, as in leucorrhœa and protracted suckling, or even a sudden assumption of the erect posture in cases of debility, may bring on more or less dimness of vision; this is not uncommon just before death.

Spectral illusions. (See Chapter viii.)

PERVERSIONS OF SMELL AND TASTE.

Perversions of smell and taste as distinguished from mere loss of these senses (see p. 147), are almost entirely limited to cases of insanity or other serious affections of the brain and nervous centres (including hysteria). Such perversions are intimately associated with the delusions from which the insane suffer, and may even give rise to some of these, especially when they suppose that their food is poisoned, that they themselves are foul and fetid, &c. Bad smells and tastes are often experienced by patients in reality, although it may be difficult or impossible at the moment for another person to verify their existence, as in slight cases of ozœna, or of gangrene of the lung, or in cases of dyspepsia with eructations of sulphuretted hydrogen or other nauseous gases. The use of certain medicines, phosphorus, and some metallic salts, likewise gives rise to curious smells and tastes. The use of bismuth sometimes gives rise to a smell resembling garlic.

NOISES IN EAR.

Noises in the ear (Tinnitus aurium) are often complained of, sometimes associated with past or present deafness, sometimes without any defect in hearing. The noises vary in degree from very slight sounds, only heard when everything around is perfectly still, up to noises so distressing as scarcely to be bearable. They are often traceable to some mechanical cause, giving rise to pressure on the labyrinth, either directly or indirectly. Thus wax pressing on the membrana tympani, or obstructions in the Eustachian tube altering the pressure of the air in the tympanum, can sometimes be shown (by the effect of their removal) to have been the cause of tinnitus. It should be remembered, however, that apparently similar obstructions may exist without producing this symptom. Perforation of the membrana tympani, when caused by violent noises, &c., is almost always associated with tinnitus for a time, although not itself a cause of this symptom; in cases of deafness, also, brought on by blows on the head, tinnitus is often present. In certain cases the noises in the ear seem to be due to actual mischief in the labyrinth itself, and especially to pressure of the stapes on the foramen ovale; such pressure may arise from disease of the external, middle, or internal ear. A lesion of the labyrinth is especially probable in those cases where the noises are associated with some degree of deafness, and with sudden and violent attacks of giddiness, and a tendency for the patient to turn or to fall to one side (Ménière's disease). Occasionally the noises in the ear appear (like certain forms of deafness) to be purely nervous, coming and going irregularly, or especially produced or aggravated in connection with mental annoyance and over-fatigue; or developed, like certain forms of weak sight, by prolonged lactation, &c. Noises in the ear have, in certain cases, their explanation in disturbances existing in the brain itself, or in its circulation; like flashes of light, they form part of the prodromata of apoplectic attacks. In certain cases of acute diseases (typhus), and in some nervous complaints, the hearing is abnormally acute, so that very slight sounds, otherwise likely to escape notice, seem to be painfully loud, although in other stages of typhus and enteric fever deafness is often present. Quinine in full doses often produces more or less noise or ringing in the ears; great differences exist as to the susceptibility of patients in respect of quinine. Salicine and salicylic acid may also give rise to the same symptom. Sometimes the noise or singing in the ears is due, in all probability, to the patients actually hearing sounds produced in their own veins; possibly they sometimes hear sounds produced by the circulation of the blood in the rigid arteries at the base of the brain in cases of atheroma.

A whiffing sound, as if close at the ear, corresponding with the arterial pulsations, is often complained of by persons affected with some disorder of the heart's action (usually of a functional character), and associated with a sense of throbbing throughout the arteries; this sound distresses them chiefly while lying on the left side, and indeed often renders this posture in bed impossible.

DIMINUTION AND PERVERSION OF THE CUTANEOUS SENSIBILITY.

Anæsthesia is described by patients as a "numbness" or "deadness" of the affected parts, or occasionally as if thickened skin, leather, India-rubber, or even air cushions were interposed between their feet, or other affected parts, and the objects touched. These sensations may be regarded as due to pure defects. Associated with anæsthesia, there may be in the same part "*hyperæsthesia*," that is to say, painful sensations from irritations which in the normal state would scarcely be noticed: thus a light touch affecting, perhaps, only the hairs of the skin, or a slight current of air, may be felt by such patients as acutely painful: but as there is in hyperæsthesia no real increase of delicacy in touch, but almost always a diminution, the term "paræsthesia" would better express this perverted sensation. The feeling of "*pins and needles*" in a limb (*Scotticè* "*prinkling*") is often complained of in paralysis: the feeling is somewhat similar to that experienced by every one at times when by accident undue pressure is made on certain parts of a limb, as on the arm by lying on it, &c. Allied to this tingling is the feeling as if small insects were crawling over the body ("*formication*"); other creeping feelings, and sensations as if the hairs of the body were standing on end (*horripilation*, goose-flesh), are complained of in various nervous affections, and also in febrile disturbances. *Feelings of flushing*, both local and general, and *of coldness*, or of cold water trickling down a part, are often experienced in nervous affections, especially hysteria and hypochondriasis, as well as in certain febrile states (see Pyrexia, p. 87). *Coldness of the limbs* is often bitterly complained of in paralysis, although the parts may seem only slightly colder than natural. A feeling of *constriction of the trunk*, as if the clothes were too tightly fastened around the body, or as if a card were tightly compressing it, is often present in spinal affections. Some of the above perverted sensations pass into, or are associated with actual pain in various parts.

TESTING OF THE CRANIAL NERVES.

In many cases of paralysis the critical examination of the cranial nerves may enable us not only to pronounce on the cerebral nature of the illness, but even to localize the lesion in some part of the brain. In certain cerebral affections, moreover, it occasionally happens that only one or two nerves are paralyzed, and these may escape attention unless we test the nerves systematically: variations in the paralysis likewise occur from time to time, in certain cases of cerebral tumor, and even a more transient paralysis of these nerves is sometimes seen in cerebral abscess.

FIRST NERVE.—Olfactory—supplies the sense of smell. (See pp. 146 and 158.)

SECOND NERVE.—Optic, the nerve of vision. (See pp. 138–144 and 154–159.)

THIRD NERVE—Motor oculi—supplies directly, or through the lenticular ganglion, the sphincter muscle of the iris, the ciliary muscle, the levator palpebræ, and all the muscles of the eyeball except the superior oblique and external rectus. These muscles should be tested separately. (See pp. 128–138 and 154, 155.)

FOURTH NERVE—Patheticus, Trochlearis—supplies the superior oblique muscle of the eye. (See pp. 133-135, and 155.)

FIFTH NERVE—Trifacial, Trigeminal—is partly motor, but its largest part is purely sensory. The *motor branches* are derived from the small root of the nerve. These motor branches are all given off from the inferior maxillary portion. They are distributed chiefly to the muscles of mastication, viz., the temporal, masseter, and internal and external pterygoids; the mylo-hyoid, and the anterior belly of the digastric, likewise, are supplied from this source. The power of closing the jaw perfectly, and of moving it laterally, affords evidence of the soundness of these branches. The buccinator muscle was formerly supposed to be supplied by the fifth, but it is now recognized that the buccal branch of this nerve is sensory, and that the motor supply comes from the seventh. The motor branches from Meckel's ganglion going to the palate and uvula are supposed to be derived from the seventh nerve. The *sensory branches* supply common tactile sensation to the skin of the face from the forehead to the chin, to the mucous surfaces of the mouth, tongue, palate, and uvula; the conjunctiva, the mucous membrane of nose, and the teeth are all supplied from this source. In addition, the lingual or gustatory branch supplies probably some portion of the special sense of the tongue, (apart even from the fibres of the chorda tympani nerve mechanically united with it). The fifth nerve has, moreover, very important functions connected with the nutrition of the eyeball, of the hairs, and other parts to which it is supplied. When affected as far back as the Glasserian ganglion, sloughing of the cornea, and other trophic changes have been observed. The tests applied in judging of the sensory branches of this nerve are by means of the compasses for the common tactile sense of the skin, tongue, and lips; by tickling the palate or uvula for the production of reflex action, acting on one side only at a time; by test solutions for the special sense of the tongue (see Taste, p. 148); and by examination of the clearness of the cornea, the color of the eyebrows, the amount and character of the secretions of the nostrils, &c., for any trophic changes in affections of this nerve. Pain or neuralgia in the situations enumerated above may be referred to this nerve.

SIXTH NERVE—Abducens oculi—supplies only the external rectus of the eye. Deficiency in the power to move the eyeball outwards is the sign of paralysis of this nerve, but care must be taken to ascertain that the eyeball is not fixed from inflammation, abscess, or tumor of the orbit. In slighter forms, diplopia may be the only evidence of this paralysis. (See pp. 129–135 and 154.)

SEVENTH NERVE (PORTIO DURA)—Facial.—This nerve is essentially motor, but some communicating branches are still involved in doubt as to their exact function. The muscles directly supplied include all the great muscles of expression, and in judging of their healthy or paralyzed condition, it is desirable to get the patient to laugh, to whistle, or to simulate expressions of surprise, &c. These muscles include those of the external ear, the occipito-frontalis, corrugator supercilii, orbicularis palpebrarum, the muscles of the nose, cheek, upper and lower lips, the orbicularis oris, buccinator, stylo-hyoid, part of the platysma, and the posterior belly of the digastric. In addition to these, the facial sends a branch to Meckel's ganglion—the large superficial petrosal nerve—and it is probably from this source that the motor supply of the azygos uvulæ and the levator palati is derived. The facial, moreover, sends a branch—the chorda tympani—to join the lingual or gustatory of the fifth; and it is now generally agreed that the chorda tympani supplies the sense of taste in the anterior part of the tongue (see Taste, p. 148). The facial also supplies the intrinsic muscles of the tongue (lingualis).

In examining cases of paralysis of the portio dura, attention should be specially directed to the occipito-frontalis and the orbicularis palpebrarum; these are usually paralyzed to a marked extent in lesions affecting the trunk of the nerve, so that the eye often remains uncovered and waters readily, or even becomes seriously affected from exposure. These muscles often escape in large part in the facial paralysis due to general cerebral causes (hemiplegia). The mouth is usually also badly affected in lesions of the trunk of the seventh, so that the patient cannot whistle, and from paralysis of the orbicularis oris the saliva may escape: from the flabby state of the buccinator, the food often accumulates helplessly between the cheek and the teeth. All these symptoms are usually much more marked in cases of paralysis from peripheral causes than in those from central affections. Deviation of the uvula or unilateral paralysis of the palate sometimes leads to a diagnosis of a lesion behind the origin of the petrosal branch in the tympanum (the nervus petrosus superficialis major arises at the intumescentia gangliformis). The palate hangs loosely on the paralyzed side, and its reflex movements are lessened: it may also be drawn to the sound side. The uvula sometimes deviates to the paralyzed side, sometimes to the sound side. It is not always quite even in the healthy state. (Its deviation to the paralyzed side has been explained by the unopposed action of the pharyngopalatine muscle.) Paralysis of the seventh nerve may affect the movements of the tip of the tongue, especially the pointing of it or the moving of the tip in various directions when protruded. It is also quite certain that some loss of taste occasionally exists in the anterior part of the tongue in peripheral paralysis of the facial nerve. The hearing should be tested carefully in paralysis of the portio dura.

Facial paralysis sometimes exists on both sides (bilateral or double facial paralysis). In such cases the face is symmetrical but expressionless. It may arise from a combination of right and left aural disease, or from accidental combinations of other peripheral forms of facial paralysis. It is most commonly, however, due to disease in the pons Varolii or medulla oblongata, and constitutes in this way a feature of progressive bulbar paralysis. (Glosso-labio-laryngeal Paralysis.)

SEVENTH NERVE (PORTIO MOLLIS)—Auditory.—This nerve is purely auditory: disorders in it show themselves by deafness, noises in the ear, and occasionally vertigo (see pp. 144 and 158).

EIGHTH NERVE—GLOSSO-PHARYNGEAL—is almost purely sensory; it supplies sensation to the tonsils and pharynx, and so is greatly concerned in the reflex actions of swallowing: it supplies the back part and the sides of the tongue with special sensation, and is distributed to the circumvallate papillæ. It supplies the mucous membrane of the tympanum and Eustachian tube with sensory fibres. It may be tested by attempting to produce reflex actions, by tickling the pharynx, and by test solutions, especially bitter fluids, applied to the back of the tongue (see Taste, p. 148).

EIGHTH NERVE—SPINAL ACCESSORY.—The portion of this nerve which arises from the medulla oblongata (bulbar portion) seems to be distinct in function from that arising from the spinal cord. Both roots are purely motor. The fibres from the former enter the branch communicating with the pneumogastric, and are distributed to the muscles of the pharynx and larynx (through the superior and recurrent laryngeal nerves). The fibres derived from the spinal portion of the nerve are distributed to the sterno-mastoid and trapezius muscles. Disorder of the roots of the spinal accessory nerve may therefore give rise to laryngeal and pharyngeal disorders, or to convulsive or other affections of the trapezius or sterno-mastoid.

[Laryngeal disorders may also arise from affections of the recurrent laryngeal nerve, due to aneurismal or other tumors in chest. Glosso-labio-laryngeal paralysis is probably associated with, and in part due to, an affection of this nerve.]

EIGHTH NERVE—PNEUMOGASTRIC.—This nerve has such a wide distribution, such important connections with other nerves, especially the sympathetic, and still remains in so much obscurity as to certain of its functions, that no attempt need here be made to detail its sphere of operation. The student may remember, in the present connection, that it supplies the mucous membrane of the pharynx and larynx, and also the muscles of both, although, as mentioned in the preceding section, this motor portion is derived probably from the spinal accessory. The thyroid gland also derives its supply from the pneumogastric; and the heart, lungs, œsophagus, stomach, bowels, liver, and spleen all receive important nervous filaments, either directly from this nerve, or from the cardiac, pulmonary, and other plexuses to which it gives branches. Aphonia, dysphagia, vomiting, constipation, palpitation, intermittent pulse, hepatic disorder (including diabetes), and respiratory disorders and distress, may all, at times, be referred with more or less probability to an affection of this nerve in some part of its course.

NINTH NERVE—Hypoglossal—is purely motor. It supplies all the depressor muscles of the hyoid bone, receiving some important fibres from the second and third cervical nerves through the communicans noni. The genio-hyoid and the omo-hyoid are also supplied from the same source. It also supplies the (extrinsic) muscles which act on the tongue, and it even gives a few terminal fibres to its intrinsic muscles (lingualis). This nerve, therefore, is concerned in deglutition and in the movements of the tongue. Paralysis of this nerve on one side leads to protrusion of the tongue *towards* the paralyzed side, from the unopposed action of the sound genio-hyo-glossus. If extreme, as in cases of injury, the paralyzed side is flabby and falls into wrinkles, but there is no loss of tactile or gustatory sense. The tongue is usually deviated to one side from affection of this nerve in hemiplegia, and in glosso-labio-laryngeal paralysis the ninth nerves are clearly involved.

CHAPTER VI.

SYMPTOMS OF DISORDER IN THE NERVOUS SYSTEM.[1]

PARALYSIS.

PARALYSIS is usually understood to mean a loss or diminution of motor power; occasionally the term is applied to sensory as well as motor nerves, in which case some lesion of the function is signified.

The distribution of the paralysis is one of the first points to be investigated. "Hemiplegia" is the name given to a paralysis of one lateral half of the body, especially of one arm, one leg, and one half of the face; the paralysis of the face is usually on the same side as that of the limbs; when it is on the opposite side it is termed "alternate hemiplegia," or "crossed paralysis." "Paraplegia" is technically applied to a paralysis of the lower part of the body; the legs and the lower part of the trunk, including at times the bladder and rectum, are the parts usually affected. "Monoplegia" is a term applied to paralysis of one limb. Paralysis is sometimes limited to the lower limbs or even to the parts below the knee, to the arms, or to the forearms (especially in cases of infantile paralysis, lead poisoning, wasting palsy, and traumatic paralysis). Paralysis of the face often exists without any affection of the limbs; it is usually one-sided, but occasionally double. (See Paralysis of portio dura, p. 162.)

Beyond these obvious distinctions we must be on the watch for more definite anatomical and physiological variations in the distribution of the paralysis; thus we have affections of single nerves (as the sixth), or of special divisions of a nerve as in the case of the third cranial nerve (see pp. 135, 161), or of the musculo-spiral nerve and the like. Or we may have special muscles or groups of muscles paralyzed, as in the case of the deltoid, and the muscles of the thumb in muscular atrophy; and of the extensors of the forearm, with the immunity of the supinator longus, in lead paralysis. Again, the distribution of the paralysis may affect special processes, as in paralysis of deglutition, articulation, &c., — various nerves and muscles being implicated together.

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[1] The following works are specially valuable for consultation. Some of those referred to in last chapter are likewise important. Reynolds's System, Vol. II., Trousseau, Vol. I., Ziemssen's Cyclopædia, Vols. XI., XII., XIII., and XIV.; also West and other writers on Diseases of Children; Duchenne's Treatise on Electricity contains many important chapters, particularly on Ataxy and various forms of atrophic and pseudo-hypertrophic paralysis. See also Hammond, Althaus, Charcot, Mitchell, Bateman.

The delicate exercise and co-ordination of the movements required in the complex use of the vocal organs, of the hand in writing, and of the feet and legs in walking, may be greatly impaired in cases where paralysis in its ordinary sense of want of motor power can scarcely be affirmed. Such a condition is observed in locomotor ataxy, general paralysis of the insane, writer's cramp, shaking palsy, and some other affections.

The state of the patient as to intelligence, and his general mental and emotional condition, are to be noticed particularly in the examination; they are likewise to be considered in connection with the previous history of such paralytic attacks. This inquiry is of special weight in cases of hemiplegia, of paralysis of the cranial nerves, and in general paralysis of the insane. It is evident also that we must ascertain how far the mental condition of our patient can be relied on before we submit him to tests, the value of which turns largely on his intelligent co-operation. We seek to know if any period of unconsciousness occurred in connection with the paralysis, and at what stage of the illness it supervened, what warning was given of the attack by headache, sickness, giddiness, or the like, what was the depth of the unconsciousness and the period of its duration, whether it was associated with convulsions, of what kind these were, whether the unconsciousness had passed away or still continued to any extent. (For observing paralysis in unconscious states, see Fits; Sudden paralysis, p. 194.) We have often to inquire, moreover, whether the intelligence was affected before the paralytic attack, or during its onset, or only since its establishment. We must test the intelligence, by questioning the patient on subjects with which he is known to have been familiar, or we may have to take the opinion of his friends on this point.

Associated with more or less diminution of the intelligence, and occasionally without any indication of weakness in this respect, we observe in some forms of paralysis an excessive mobility of the emotional nature, manifesting itself in some patients by weeping, and in others by laughing without any adequate cause; in some there are alternations of both conditions. Irritability of the temper, and very great changes in the moral character, not unfrequently date from paralytic attacks.

The sensations of the skin are often affected—sometimes impaired and sometimes perverted. (For tests of anæsthesia, see Organs of Sense, p. 150; and for perverted sensations, see Subjective disorders of same, p. 160.) When sensation is intact this should be mentioned. When an affection of the sensibility can be determined, this should be defined as to its distribution, and compared with the distribution of the paralysis; in some regions, as in the case of the abdomen, we are able to form a more accurate notion of the level of a spinal lesion by considering the range of the anæsthesia than by merely considering the range of the paralysis. When this affection is limited to one lateral half of the body, it is termed "hemi-anæsthesia;" this is compartively a rare occurrence in hemiplegia, and of much diagnostic importance when present. Hemi-anæsthesia may also exist without muscular paralysis. (Compare p. 152.)

The limitation of anæsthesia to the area supplied by a particular nerve, as in the case of the fifth nerve, is of great diagnostic value; this may concur with paralysis of the muscles of mastication supplied by the same nerve. Similar combinations of anæsthesia and paralysis, in the regions supplied by special nerves, nerve trunks, or plexuses, may be seen in various affections, especially in traumatic cases, and, as already mentioned, in serious lesions of the cord.

Paralysis often exists to a marked extent without anæsthesia, or with little alteration as regards sensation. In ordinary hemiplegia, well-marked anæsthesia is rare. Even in many cases of paraplegia the anæsthesia is slight. In infantile paralysis the sensation is almost invariably preserved, and the same may be said of lead palsy.

Pain and Paralysis are sometimes combined. In such cases we must first ascertain, if possible, whether the apparent paralysis may not really be due to the pain. In severe neuralgia of the face, or of a limb, or in pain from diseased joints and the like, the parts cannot be moved on account of the commanding nature of the pain; in cases of muscular pain, as in a stiff neck, the absence of motion is no doubt partly of this nature; in certain forms of what is termed "rheumatic paralysis," however, the inability to move the part affected seems to be partly owing to this pain and partly to a rheumatic affection of the nerves or their sheaths impairing their function. When the pain in paralysis is not of this character, we ascertain if the muscles of the affected limb are tender on pressure, or if the pains come in severe darts of momentary duration, or, if they are associated with cramps, permanent contractions, or startings of the limbs. Thus cerebral meningitis is often associated at its commencement with a generalized hyperæsthesia, and this is likewise noticeable in some cases of hemiplegia; spinal meningitis, by its attendant pains, may simulate rheumatism; lesions of the cord may give rise to pains resembling sciatica and other forms of neuralgia, and "electric" or "toothache-like" pains in the legs are habitual in locomotor ataxy; the pain at the beginning of infantile paralysis may be such as to give rise to a suspicion of hip joint diseases; pains of various degrees of intensity occur likewise in wasting palsy.

The condition of the paralyzed limbs and muscles must be ascertained. Differences in thickness and in temperature are often found even in recent cases of the atrophic paralysis of infants, and in old cases of various forms of paralysis. Occasionally a relative increase of temperature can be made out in the paralyzed limbs in the early stage of hemiplegia, but a slight difference in the opposite direction is much commoner later on. The muscles are to be examined as to their bulk; we look to see whether they are apparently larger (pseudo-hypertrophic muscular paralysis) or smaller and softer than natural, and in judging of this we must allow for the changes brought about by disuse from any cause; wasting is specially noticeable in cases of mechanical injury of the nerves, in wasting palsy, infantile paralysis, and certain other forms of spinal paralysis. Small fragments of muscle have been sometimes removed by Duchenne's *emporte-pièce histologique* to ascertain whether the muscular fibres have undergone fatty degeneration, or have been replaced by fibrous tissue. We also examine the muscles as to the power remaining in them; the dynamometer is sometimes useful in recording the force, especially as a test of improvement or deterioration in this respect; considerable variations occur with the dynamometer from the varying tact employed by the patients in using it. Grasping the fingers of the observer, pushing the foot against one's hand, raising the arm into certain positions, and holding out weights, &c., may be mentioned as rough tests of the muscular power. Coarse trials of mere strength like these may fail to reveal defects in the more delicate exercise and adjustment of the muscles required in using tools, in writing, sewing, &c. Unsteadiness may come into play likewise to spoil the muscular movements (see pp. 170, 171, and 190).

The electric exploration of muscles is of considerable value; this is dealt with in special section (see Electrical Instruments, Chapter vii.) The so-called muscular sense is also dealt with in another place (see Chapter v., p. 153).

The condition of the muscles as to permanent contraction, movements, and tremors must be considered in cases of paralysis. Rigidity of the paralyzed limbs should be inquired into as to whether it appeared at the beginning of the paralysis, or not till some months or years afterwards (early and late rigidity). Early rigidity denotes a lesion giving rise to irritation of the motor ganglia, and is often associated with lesions of the cortical portions of the brain, including its membranes, and with certain forms of spinal meningitis. Late rigidity depends probably on changes induced by the contraction of nervous tissue during the cicatricial process. We must try whether we can stretch out the rigid limbs, and whether this causes pain; also whether any involuntary movements exist in the contracted member, whether the contraction is associated with tonic spasm of the muscles, and whether this spasm, if present, ever gives way to relaxation.

Involuntary movements in paralyzed limbs must be noted when present. In chorea the erratic movements are often complicated with a certain degree of paralysis. Both the movements and the paralysis are usually more pronounced on one side than the other. Occasionally the chorea is limited to one side (hemichorea), and the paralytic complication, when present, usually attacks the side chiefly affected with the twitchings. This paralysis generally follows the chorea, sometimes precedes it. Of a somewhat similar nature is the transient hemiplegia which sometimes follows epileptic attacks (epileptic hemiplegia).

Unilateral convulsions sometimes usher in a hemiplegia; sometimes such convulsions occur or recur in the course of the paralysis. Such convulsions may take place without loss of consciousness, and may be limited to a paralyzed arm or leg.

Paralyzed limbs sometimes move involuntarily in connection with automatic actions, particularly the arm in the act of yawning. Movements of the legs, quite involuntary, are common in paraplegia; where the spinal cord is seriously destroyed, these may be very marked and even violent; they are often produced by very slight irritations acting in a reflex manner; occasionally the exciting cause is plain enough, as when the irritation is from exposure to the cold air, or from movements of the bed-clothes, &c.; but sometimes the cause is not apparent, being perhaps hidden from view; the urinary passages and the bowels are no doubt at times the seat of such hidden irritations.

Choreic movements sometimes become developed in paralyzed limbs in hemiplegia (post-hemiplegic chorea); these differ from Dr. Hammond's "athetosis," as in this latter affection there is no history of pre-existing hemiplegia, although a certain loss of power may coexist with it. A minute fibrillary quivering is observed sometimes in cases of muscular atrophy, and is very noticeable in the tongue and lips in general paralysis, delirium tremens, and some other affections.

A degree of irregular muscular movement or tremor is seen in certain forms and stages of cerebral and cerebellar disease, locomotor ataxy, and general paralysis; some of these peculiarities will be noticed in the section on unsteadiness in balancing the body, and in walking; such complex efforts bring out the deficiency in a marked manner. (See p. 172.) It must not be forgotten that simple weakness renders the limbs unsteady as well as feeble, and various febrile states intensify the trembling as well as the weakness (delirium tremens, typhus, &c.).

Shaking of the paralyzed limbs is not uncommon in hemiplegia, tremulous vibrations differing from choreic movements in being somewhat rhythmical in their character and much more limited in their nature; this general shaking of the whole limb resembles that which occurs after an unwonted muscular effect. We may have this shaking developed without any preceding hemiplegia or paralysis, although when established it amounts to a virtual paralysis, and is named "Paralysis Agitans," or "Shaking Palsy." Such shaking is often unilateral; sometimes it affects only one limb; sometimes the head is notably affected with similar shaking or nodding movements. Along with this shaking we often observe emotional disturbances, and sometimes that peculiar gait termed "festination," in which the patient has to hurry on to keep himself from tumbling forwards, always "in pursuit of his centre of gravity," as has been said. Such affections are commonest in the aged, or those past middle life; but a similar affection, due to cerebral or spinal sclerosis, is sometimes seen in young persons. "Nodding convulsions," with nodding, bending, rotating, or bowing of the head or of the body, constitute a rare disease observed in young children; it is described also under the names of "Eclampsia nutans," and "Salaam convulsions."

Somewhat intermediate between chorea-like movements and shaking palsy are the tremors seen in mercurial paralysis, and some other forms of metallic poisoning. The occupation of the patients, and the existence of salivation, &c., assist us in the diagnosis.

Reflex action in paralyzed limbs accounts, as already indicated, for many involuntary movements in the parts, but we may have to produce it experimentally by tickling the soles of the feet, and by similar irritations, avoiding painful impressions. Reflex action is often preserved and even much heightened when the cord is seriously destroyed in a limited part of its course. This excessive action is probably due to the controlling influence of the brain being cut off. When reflex action is preserved, we infer the essential integrity of the cord at the part where the afferent and efferent nerves concerned in the experiment enter the spinal cord. The reflex action may be perfect although there is complete loss of sensation. When the reflex action is preserved the nutrition and electric condition of the muscles are usually but little impaired.

Walking and Balancing in Paralysis.—The power of balancing the body varies much in different forms of paralysis, and it is sometimes very deficient in cases where the loss of muscular power is but slight. This want of power in balancing often comes out when the patient tries to walk. In children the complaint of inability to walk is sometimes made when the real defect is in the intelligence (idiocy). Lateness of walking in children often arises from a general defect due to rickets, apart from any true paralysis. The manner of walking must always be scrutinized in cases of paralysis. In hemiplegia the paralyzed leg is often swung round from the trunk, and the toe of the paralyzed leg may drag or scrape as it goes along, so that it makes a mark, for example, on a gravel walk. When infantile paralysis affects one of the lower limbs, the chief deficiency is almost invariably below the knee, and when the loss of power is not extreme, the foot is swung round or "thrown," as the parents say, in a very characteristic manner. In paraplegia the feet may almost be said to be trailed along when the paralysis is considerable; when one leg is worse than the other this trailing often serves to distinguish it. In less severe cases the feet and legs are lifted with an obvious effort. We must also notice whether the patient walks on his toes, from spasm or contraction of the muscles and tendons of the calf of the leg, or on the side of the foot, from partial paralysis of special groups of muscles, or, more rarely, on the heel from a similar cause. The hurrying gait, known as "festination," already mentioned, may exist in all degrees from a slight hurrying and a slight difficulty in stopping, up to the most extreme running and staggering forward in a way that is quite alarming.

Staggering in a most extreme form is often found in disease of the cerebellum, so that the patient in a bad case cannot make a few steps forward without staggering to the one side. Similar deviation to the one side is one of the symptoms in Ménière's disease. (See p. 159.)

In locomotor ataxy and in general paralysis there is frequently very marked unsteadiness in walking and standing, but special tests require to be applied in some cases to bring this out. We ask the patient to walk along a given line; the seam of a carpet or a plank of the floor answers for this purpose. Or we ask him to put his feet together and to stand still; or we ask him to stand on one foot and then on the other. In ordinary paraplegia when the patient gets fairly in the erect position he can often stand very firmly; any deficiency in this respect usually arises from the knees giving way from muscular weakness, and with care in adjusting himself such a person can even stand on a single foot. In locomotor ataxy this power is remarkably diminished. A patient who can walk fairly is unable to stand steadily, he cannot get a "grip of the ground," he says, and requires to spread out his feet and to keep a strict watch with his eyes on the ground. This relationship of the sight to the power of balancing must be specially considered in cases of suspected ataxy. It comes out to its greatest extent when the patient puts his feet close together and tries to balance himself with his eyes shut; a good method of testing, especially with the view of tracing any improvement or deterioration, is to count the number of seconds during which such a patient can thus remain; care must be taken to have assistance at hand, not only to prevent actual accidents, but also to give the patient a feeling of security in submitting to the test. A further indication of the importance of the eyesight in balancing comes out in the event of the patient having to walk in the dark, or, as happens in certain cases, in the event of blindness coming on; we may also apply the test by seeing how he can walk while looking up towards the roof instead of at his feet. The least catch of anything often assists wonderfully in steadying the patient in this condition, the hand, like the eye, coming to the assistance of the lower limbs. A further peculiarity in the walking of such patients consists in the way in which they very often raise their feet much higher than is requisite, and stamp them down with unnecessary force. All these peculiarities seem to depend in part on the diminished sensibility of the skin of the feet, but chiefly on a want of the delicate adjustments of the force in the various muscles required for a particular effort. A further test is supplied by the act of turning round while walking back and forward. Deficiency in this respect appears in many cases of general paralysis also.

Various defects in walking appear in connection with other affections as well as paralysis proper. The most important of these is disease of the joints and especially of the hip-joint, so that we have often to scrutinize the symptoms, measure the limb, and test for localized pain by pressure and percussion, before coming to a decision. In children, particularly, from there being often but little pain, the distinction between hip-joint disease and infantile paralysis is sometimes very difficult to establish, and a similar difficulty arises when it happens that the pains in the early stage of infantile paralysis resemble those of hip-joint disease; the measurement of the limb, the examination of the joint, the temperature of the paralyzed leg, the electrical state of the muscles, and the history of the case must guide the diagnosis. Abscesses of various kinds, involving the psoas and iliacus, and some rheumatic affections of the muscles, may give rise to difficulties in walking bearing some resemblance to paralysis.

Difficulties as to Speech require very special study in cases of paralysis. A patient may be unable to speak or to answer a question because of unconsciousness or impaired intelligence (idiocy or dementia of any kind); congenital or other defects in the hearing and in the vocal organs need scarcely be mentioned. When the inability arises from such causes, the general aspect of the patient and the previous history usually guide us aright. In other cases, the loss of articulate speech is associated with such obvious paralysis of the tongue, lips, and palate, that we can very safely refer the loss of speech, or the defective utterance, to this cause. In such cases we must test the motor power of these parts in various ways. (See seventh, eighth, and ninth nerves, pp. 162–165.) A further assistance is given in this matter by ascertaining which are the most imperfect sounds; the pronunciation of the labials in particular is often affected from paralysis of the lips, and a nasal tone may be communicated to the voice from paralysis of the palate.

Certain defects remain which cannot be explained at all in this way, and there are others which are only partially intelligible on such a view. When for example a patient cannot speak, or can only use one or two simple words to express himself, and is yet able to repeat lists of words, or even sentences dictated to him, it becomes clear that the defect is not due to any want in the muscular and nervous apparatus of the mere organs. This is equally clear in those cases where the patient's difficulty occurs only or chiefly with the names of objects and persons. To the affections of speech indicated in this paragraph the term "Aphasia" is applied.

Aphasia must be studied and described as to its various forms. The patient can sometimes express himself quite correctly in writing, although unable to speak; to this rare condition the term "Aphemia" is now applied by some. He appears sometimes to understand words addressed to him perfectly, although unable to speak, or at least to go beyond a word or two. In other cases words addressed to him may seem to convey no meaning at all. This condition must be tested by asking the patient to do certain things, carefully avoiding any gestures in making the request. He may be able to say certain words or parts of sentences while stumbling at names; he may know when the right name for the object or person is supplied to him, or he may supply wrong names, although conscious that they are wrong, and quite clear as to what he really means. He may be able to repeat words and short sentences after they are dictated to him although unable to originate them; or to say parts of familiar passages, such as the Lord's Prayer, especially when this is started for him.

Aphasic patients have usually one or two words, especially "yes" and "no;" when they have only one of these its affirmative or negative meaning is expressed by variations in the tone or otherwise. They have often certain phrases and expressions which are brought out in a parrot-like manner, although at times they are deceptive from fitting admirably as answers (*e.g.*, "I cannot tell"). Exclamations of anger, surprise, &c., and oaths are sometimes given utterance to at odd times by those quite unable to speak unless thus surprised into such emotional expressions. Aphasic patients can often sing or hum tunes, although unable to use words or only to use a few. Writing is an important test to be applied to aphasic patients. A few can express themselves in writing quite well although they cannot speak. When from paralysis of the right arm the patient cannot write, movable letters may be tried. Various degrees of ability are seen in aphasia in this respect, but anything like perfect use of writing is very rare. A strange medley of words, or stray words and confused combinations of strokes and syllables, are often shown by aphasics with obvious self-satisfaction. Some, however, can write words to dictation who cannot originate a written sentence. Many can write words and long sentences from a copy supplied to them. Some can copy from printed characters into ordinary writing; others can only copy as if by pure imitation. Some can identify their own names or the names of friends in a long list, whether in written or printed characters, although they do not know the individual letters; the general appearance of the familiar word probably guides them. Many aphasics appear to read books with interest—although probably gaining no idea from the process; we must test them as to their knowledge of what they seem to be reading. Persistent aphasia may exist along with but little diminution of high mental power, but the intelligence is usually seriously impaired, even more than might appear on a preliminary investigation.

These details indicate the points to be noted in connection with the study of the varying gradations of the affection in aphasic patients; such a note of the actual state is better than applying mere names to characterize the kind of aphasia, as these usually imply artificial distinctions and theoretical considerations not fully justified by the facts. (Aphemia, or ataxic aphasia, loss of the co-ordinating power implied in forming words,—writing being preserved; amnesia or amnesic aphasia, loss of the memory of words, &c.)

The clinical fact most frequently associated with aphasia is right hemiplegia (in rare cases there is left hemiplegia; in the latter event we should inquire if the patient is left-handed). Unilateral convulsions and other evidences of cerebral disturbance are not uncommon. The cerebral disease in aphasia is, perhaps, most frequently due to embolism of the left middle cerebral artery. The suddenness and extent of the cerebral lesion seem to play an important part in determining the occurrence of this symptom, as well as the actual portion destroyed (third anterior frontal convolution on the left side). When aphasia exists without distinct hemiplegia, it may still be clearly connected with cerebral disease. Aphasia occurs sometimes in chorea in a marked manner, and much oftener in a slight form; such attacks of chorea usually present some degree of paralysis, and of slight dementia. Aphasia without any history of paralysis of any kind is most commonly observed after severe illnesses, after enteric fever, for example, in children; it is usually only temporary in such cases. A certain number of cases of aphasia occur without definite paralysis, although the presence of cerebral disease is rendered almost certain by the existence of other symptoms.

The power of writing is often affected in paralysis; the importance of testing this has already been referred to in connection with aphasia. This concerns the power to form words and sentences, but even the mechanical part of the handwriting may afford useful indications. In paralysis agitans, in general paralysis, and in the forms of locomotor ataxy affecting the arms, the unsteadiness is shown in the writing, and even when one cannot observe this distinctly, there is sometimes clear proof of a departure from the usual character of the writing. This affection of the writing varies considerably at different times, and is apt to be made worse by having the attention of on-lookers directed to the writer. When there is anæsthesia of the fingers, or paralysis of the muscles of the hand and thumb, the writing is also apt to be affected.

Different from all these is the peculiar spasm which seizes the fingers in "writer's cramp;" when the patient begins to use the pen, the movements soon get to be beyond control, and the pen cannot even be held. In less severe forms the spasm only appears after a certain amount of writing has been done, and the difference in the character of the writing at the end from the beginning can be readily noticed. When there is any form of affection of the writing it is well to preserve specimens, containing the date, for comparison subsequently.

PARALYSIS OF THE BLADDER AND RECTUM is an important fact in cases of paraplegia, and always constitutes a grave complication. This paralysis may show itself either by want of power in retaining the excretions till a suitable opportunity occurs (incontinence, paralysis of sphincters), or in a want of power in expelling the contents (constipation, retention of urine). It does not occur in hysterical paraplegia in a persistent form, although occasional retention of urine is often present in hysterical subjects. This form of paralysis is likewise almost unknown in infantile paralysis. But before considering paralysis, properly so called, reference may be made to conditions which simulate paralysis of these parts. The presence of coma or unconsciousness from any cause, often leads to untimely intestinal and urinary evacuations, quite apart from any other defect. Similar causes may lead to retention of the urine; this is, perhaps, commoner in the unconsciousness found in serious febrile derangements, and in nervous lesions giving rise to paralysis of the nervous centres. Retention of urine is common in connection with injury of the parts, and after operations in the neighborhood of these organs (severe or instrumental labor, operations for piles, &c., may be named amongst these). Such retention may indeed be due to an inhibitory form of paralysis. Retention of the urine in connection with stricture or enlarged prostate, although no doubt partly due to nervous spasm, really arises from distinct mechanical impediments. Dribbling away of the urine may be due to disease of the bladder, such as cystitis, arising from calculus or other causes; it may also result from the organ having been habitually, or on some special occasion, over-distended so as to injure the muscular structures. Involuntary evacuation of feces, apart from injury of the parts, may also result from great fluidity and frequency of the motions, from profound debility of the patient, or from anæsthesia of the anal aperture, so that due warning is not transmitted. Such motions occur also in idiotic persons. A form of local paralysis of the rectum, leading to retention of feces, is found in cases of constipation where the bowel has been habitually or enormously distended. The condition of irritability or spasm of the organs may lead to discharge of the contents beyond the patient's control. Dysentery, and other diseases characterized by tenesmus, cystitis, calculous disease of the bladder and kidney, &c., may act in this way, apart from any paralysis. (See Disorders of defecation and urination, Chapters xi. and xiii.)

Spasmodic discharge of the urine, however, also occurs in spinal paralysis—the bladder contracting on its contents with great force, and without much warning, and the patient being quite unable to restrain or delay the process. A somewhat similar suddenness and violence of contraction may also occur in the bowel, by which the patient is apt to be "taken short," as he says. Irregular action in this way sometimes occurs in locomotor ataxy as part, apparently, of the general incoordination.

Wetting the bed in the early hours of night is often complained of in the case of children (Enuresis, Nycturia). This seems also to be usually due to some form of spasmodic action, as it tends to occur soon after going to sleep, and long before the bladder can be much distended; indeed it often only occurs during the early hours of sleep, and not at all later on, although there is then much more distension; during the day there is no urinary trouble in such cases. This ailment usually persists in the children affected for a considerable time, and seems due to some nervous defect. Wetting the bed occurs also in chorea. It sometimes affords an early indication of the occurrence of epileptic fits happening during the night. After enteric fever, and perhaps some other acute illnesses, this defect is occasionally noticed as a passing fact, in cases where there had been no trouble with the bladder during the height of the fever. It occurs especially in little girls, and seems part of the general weakness, both mental and physical, often found after this fever.

Paralysis of the bladder may show itself by retention, or by incontinence, or by spasmodic discharge of urine, in the same case: beginning as retention, incontinence may follow; or beginning with an irregular spasmodic action of the bladder, retention or incontinence may supervene.

Paralysis of the bladder is found in many cases of hemiplegia during its early stage, but it usually passes away as the patient partially recovers. Sometimes, however, it is permanent, and this is more likely to happen if the bladder has been neglected and allowed to be over-distended during the period of unconsciousness. Paralysis of the bladder is very common as part of the paralysis due to spinal lesions in the lower dorsal or lumbar regions, and in such cases it is more apt to be permanent. In whatever way the urinary affection begins, it tends to the form characterized by incontinence, and disease of the bladder itself (cystitis) is also often present, produced partly, perhaps, by distension or by the use of instruments, and favored by the alkaline urine often secreted in spinal paralysis.

A reflex paraplegia, originating from disease of the genito-urinary organs, is alleged to occur sometimes, and in any case we should try to ascertain the exact sequence of events; serious disease of the bladder occurring distinctly before the paralysis of the limbs points in this direction, but an incipient paralysis may manifest itself by urinary disturbance as an early symptom: sometimes, indeed, an affection of the bladder remains the only evidence of paralysis for a long time.

Paralysis of the bowels usually manifests itself chiefly as a more or less obstinate constipation; this can usually be overcome by medicines, but occasionally it is so extreme as to suggest some serious obstruction, especially when from any cause vomiting supervenes. The paralysis may also affect the sphincters as already mentioned.

THE CLINICAL SIGNIFICANCE OF PARALYSIS in the various forms in which it appears has been alluded to occasionally in connection with special symptoms: the subject is so complex that reference must be made to the text books under such headings as Hemiplegia, Paraplegia, Diseases of the Spinal Cord, &c.

Hemiplegia almost invariably implies a cerebral lesion; a few cases of spinal hemiplegia, however, have been recorded. When the face is involved in the hemiplegia, the diagnosis of some cerebral lesion may be made with confidence, and the lesion is always on the side of the brain ***opposite*** to that on which the limbs are paralyzed. The causes of the lesion must be searched for: we examine the state of the arteries for indications of rigidity, of the cornea for appearances of the arcus senilis, and of the heart for evidence of hypertrophy. When these exist in a hemiplegic patient not very much advanced in years, they strongly suggest a hemorrhagic lesion, and if the paralysis has been complicated by the occurrence of a fit of unconsciousness, with lividity and stertor, this may almost be regarded as certain. These remarks apply whether there is any evidence of chronic disease of the kidney or not; but the existence of such disease renders a hemorrhagic lesion in such a case even more probable.

When there is valvular disease of the heart (with or without evidence of hypertrophy), we must keep in view the possibility of embolism: such attacks are usually sudden, and may or may not be attended by unconsciousness: embolism is, on the whole, commoner in the middle cerebral artery of the left side than in any other part of the brain, and this is a frequent cause of aphasia.

The cerebral lesion in hemiplegia may be of the nature of softening; this may be a consequence of embolism, but may also arise from other forms of disease in the vessels (atheroma, thrombosis). Syphilitic lesions sometimes give warning of their presence, before the development of hemiplegia, by affections of single cranial nerves (third, sixth, and seventh in particular); these are sometimes recovered from, other nerves again becoming involved; syphilitic lesions often determine convulsions, occurring sometimes in connection with the beginning of the paralysis, sometimes before, and sometimes after it. Occasionally hemiplegia and paraplegia exist in the same subject from syphilitic lesions affecting both the brain and spinal cord; the indications of a multiple nervous lesion—one not easily explained by the simple growth of a tumor or the mere extension of the diseased condition—should always suggest syphilis. The existence of syphilitic nodes, iritis, retinitis, &c., must be inquired for, and the history of primary sores can sometimes be obtained in clearly syphilitic cases, although there may have been no appearance of secondary symptoms; in nervous cases the date of such infection is often very remote. Tumor often causes paralysis of special cranial nerves before hemiplegia appears, or quite apart from it; in these cases the ophthalmoscopic appearances are specially important; the comparative frequency of chronic tubercle of the brain and its membranes must be remembered in the case of children. Cerebral abscess may produce variable states of coma, and a shifting paralysis of various cranial nerves; it is frequently indicated by the occurrence of shiverings, and sometimes special sources of purulent infection can be found (suppuration of the tympanum, from disease of the bones, from scarlatinal sore throat, &c.). Tumor and cerebral abscess are both apt to give rise to convulsions as well as to hemiplegia. Hemiplegia occasionally complicates pregnancy, passing away, it may be, soon after delivery: the urine is almost always albuminous in such cases, but their pathology still remains obscure.

Diphtheritic Paralysis.—Paralysis of various kinds, but especially of the palate, arms, and legs, and of the accommodation of the eye, occurs sometimes as a sequela of diphtheria. It may be associated with anæsthesia. It seems to depend on a general poison rather than on serious nervous lesions.

Paraplegia may always be regarded as due to disease of the spinal cord or its membranes; even in the case of "reflex paralysis," as it is called, from irritation of the genito-urinary organs, there is probably always some lesion of the cord. In hysterical paralysis, however, which often assumes the paraplegic form, we cannot speak so definitely, and in some varieties of it, where it passes away rapidly and completely, we may be almost sure that no serious lesion exists. When the paraplegic patient complains of great pain in the limbs, as well as in the back, we suspect the membranes to be affected (spinal meningitis, whether primary or secondary); when reflex action is abolished and faradic contractility is rapidly lost, we infer destruction of some part of the cord itself, or of the cells in the anterior cornua, or of the motor roots; when reflex actions are greatly exaggerated, we infer the existence of a limited lesion in some part of the cord (see p. 172). As to etiology, we must inquire for any history of strain as well as of more obvious injuries to the column; such accidents often set up, in course of time, meningitis, or disease of the cord itself. Caries of the vertebræ is a common cause of paraplegia. This may not always manifest itself by distortion of the spine, even in cases which have gone on to the formation of psoas abscess. The influence of sexual excesses, in married life as well as otherwise, accounts for various forms of paraplegia proper, as well as locomotor ataxy. Sexual desire may be either diminished or increased in cases of disease of the cord (compare Chapter xiv.); impotence, like want of control over the rectum and bladder, is a common result of paralytic affections. Syphilitic lesions of the cord must be judged of on the same principles as those of the brain.

Infantile Paralysis is no doubt essentially a spinal paralysis, the lesion, however, involves the anterior cornua alone or chiefly; this localization accounts for the affection being almost invariably purely motor in character, for the great trophic changes, and for the limitation of the paralysis in many of the cases to one leg only or one arm. Not unfrequently, indeed, two or more limbs, or even the whole four limbs, may be attacked during the early period, the illness being characterized by pain and febrile disturbance; but the paralysis becomes, as a rule, more limited and frequently settles down to one limb, or to one group of muscles. The rapid loss of the faradic contractility of the muscles, and their response to weak currents from a constant battery for a considerable time, are points of diagnostic value. An essentially similar form of paralysis occurs sometimes, but only rarely, in the adult from a similar lesion (Amyotrophic paralysis).

In *Wasting Palsy* the muscles may be, and usually are, affected bilaterally, but one side is often in advance of the other; the muscles of the thumb and hand, the muscles of the feet, and the deltoids are amongst those most frequently affected in the early stage, but nearly every group, including the respiratory series, may ultimately become involved. The muscles usually respond to faradic electricity pretty well, considering their loss in bulk.

Paralysis of the Extensors of the forearms, and more rarely of the legs, is frequently found in lead poisoning, the other muscles being intact, and sensation unaffected. Traumatic paralysis from injury to the musculo-spiral nerve may simulate this; the history leaves no doubt in such cases; but in those forms supposed to be due to lying on the arm or to exposure to cold (so-called rheumatic), there may be, in patients exposed to lead, a certain difficulty. The immunity of the supinator longus in lead paralysis is important; it is tested by getting the patient to put his forearm in a position of half-flexion and half-pronation, and while he tries to retain it in this attitude, the observer proceeds to extend it; if the supinator longus be active it can be seen resisting this extension (Duchenne). The diminution or abolition of the faradic contractility of the muscles in lead paralysis is an important fact, as it is almost always preserved in rheumatic affections of recent origin. The presence of a blue line on the gums, the history of colic, and the occupation or surroundings of the patient are points to be scrutinized.

In *unsteadiness in walking* we must subject the patients to the tests enumerated in the section on this subject (see pp. 172–174); and we must direct our attention to their power of speaking distinctly, to the presence of any of the delusions characteristic of general paralysis, and to any history of insanity in the family. (See Chapter viii.)

Affections of speech, deglutition, &c., are specially dealt with in the sections on aphasia, and paralysis of the ninth nerve. (See pp. 174–177 and 165). For paralysis of the facial and ocular muscles, see pp. 162, 163 and 130–135.

NEURALGIA.

Neuralgia, pain in a nerve, requires to be considered as to the exact nerves or branches concerned; the whole of a plexus of nerves, the brachial or sacral especially, may be involved. The point of chief importance in considering neuralgia is to see to avoid labelling a pain as neuralgic when there is some other very definite disease merely involving the nerve in a secondary manner. In neuralgia there is, as a rule, little or no fever; the pain follows the course of certain nerves in a definite manner; it is usually, if not always, distinctly intermittent, disappearing completely at times; there are often special tender spots corresponding to the points where the nerve is superficial or passes through openings in the bones or fascia; there is no inflammation, tumor, or other disease present to account for the pain; and further, certain nerves have a special predisposition to such painful affections. The fifth nerve, the sciatic nerve, the intercostal nerves, and the brachial, lumbar, and sacral plexuses are those commonly involved. Although the absence of any obvious cause for the pain is an important diagnostic point, it is quite possible that a true neuralgia may be set up by the irritation, for example, of a decaying tooth, of a wounded nerve, of prolonged pressure, of an irritating scar, &c. Apart from these, which may set up what seems to be a *true* neuralgia, we may have pains of a reflex character; in cases of irritation of the stomach, bowels, ureter, uterus, &c., we often have pains in the head and limbs, which disappear when the irritation passes off. The pain caused by a neuroma or a neuritis may here be mentioned; there is usually very marked local tenderness in such cases.

In addition to local causes, we must have regard to the general condition, as this is very important in neuralgia. Anæmia in particular is very often responsible for this affection, and various debilitating agencies likewise lead up to it. Ague is said to be an occasional cause of supraorbital neuralgia. The hysterical tendency frequently manifests itself as a neuralgia in various parts, sometimes of a fixed, sometimes of a shifting character. Rheumatism may affect the trunk or the sheath of a nerve, and so give rise to a rheumatic neuralgia. Syphilis may operate in a similar way, or it may simulate neuralgia from the effects of syphilitic tumors in the brain or spinal cord. Sciatica is sometimes seen in the course of gonorrhœal rheumatism.

The greatest care is required in the diagnosis of neuralgia, as numerous blunders are committed in ascribing pains to neuralgia and rheumatism which are of quite a different character. Lumbago, especially in its slighter forms, must be accepted as merely a provisional diagnosis till the kidneys, the urine, and perhaps the uterus have been examined. Pains in the front of the thigh or along the sciatic nerve, and neuralgic pains in the arms and legs, generally, may really be due to serious disease of the spinal column, the cord, or its membranes, or to abscess, aneurism, and malignant tumors in the abdomen or thorax; intercostal neuralgia can seldom be safely affirmed without a careful examination of the heart and lungs, and even an apparent neuralgia of the fifth nerve may prove to be due to cerebral tumor or incipient meningitis. The influence of neuralgia on the bloodvessels and nutrition is sometimes apparent in the congested state of the affected part, in lachrymation and discharge from the nose, and in the change of color produced in the hair near the affected part.

For some points in connection with paralysis and neuralgia, see p. 169; of anæsthesia and neuralgia, see pp. 150, 160, 168.

FITS OF VARIOUS KINDS.

The nature of the seizures commonly called "Fits" varies so much, and their character is often so obscure, especially to the inexperienced, that a somewhat more general view of such attacks will be given here than is usual in systematic descriptions. This is the more necessary, as the student has frequently to discover from the description given by the patient, or his friends, the true nature of a so-called "fit" before he can estimate its significance in the previous history.

We have then to remember, amongst the possibilities—Fainting fits; fits of dyspnœa, associated, perhaps, with angina pectoris, or other forms of cardiac anguish and thoracic pain (see Dyspnœa, Chapter ix.); fits with convulsive twitchings of the face or limbs, general, unilateral, or local, with or without unconsciousness; fits associated with paralysis, especially hemiplegia, with or without loss of consciousness; fits with lividity of the face, unconsciousness, and stertorous breathing; fits with simple unconsciousness, without paralysis or convulsion; fits without absolute loss of consciousness, but with agitation, screaming, crying, sobbing, laughing, and occasionally with an approach to convulsions or to coma; fits with plastic rigidity of the limbs, which are retained in the positions in which they are placed, usually associated with some alteration of the consciousness; fits with tonic spasm of the jaw, or of the muscles of the trunk and limbs; fits with inversion of the hands and feet as a principal part of a transient convulsion, or persisting in a comparatively uncomplicated manner for hours and days. In addition to these, attacks of giddiness, or speechlessness, of cramp in the legs, of laryngeal obstruction or "crowing," and many others, are sometimes spoken of as "fits," but are usually qualified as to their nature by the patients themselves. Some of these need only be named, as their nature becomes apparent when a little attention is directed to them, either by questioning or observation. Some of them, indeed, chiefly demand attention because of their occurrence under peculiar circumstances, simulating those fits of a nervous nature with which we are chiefly concerned here. Thus a severe attack of thoracic pain or cardiac anguish may lead to much tossing about, with inability to speak, and may ultimately induce fainting and unconsciousness, so that we may be led to think of some convulsive disorder from cerebral causes.

With regard to *fainting fits*, we inquire as to the presence of any of the common causes which induce such attacks, nervous shocks, arising from fear, grief, excitement, or pain; the sight of blood, the loss of blood, the want of food and rest, especially with prolonged anxiety; exposure to the close atmosphere of crowded rooms; the existence of pregnancy, &c. Certain persons, moreover, are known to be much more prone to faint than others. In fainting fits the patient has usually some warning of the attack, and the observers may notice a preliminary pallor, or sighing, or yawning; even when these are not present in a pronounced form, the patient has often a sense of swimming, or of faintness, &c., so that in the event of his falling, he is to some extent saved by those instinctive movements of self-preservation which partial consciousness permits; the element of suddenness often serves to indicate the epileptic fit, even when it is so slight as to be otherwise liable to misinterpretation. The combination of hysterical tendencies in their less pronounced forms, with fainting fits or swoons, may give rise to considerable confusion. In a simple fainting fit the pulse is feeble, the respiration quiet, and consciousness abolished, but not usually so absolutely as in cases of coma. No twitchings occur except, perhaps, as the patient wakes up, and no paralysis precedes or follows the fit.

Convulsion fits are usually obvious enough, and can scarcely escape recognition when the whole phenomena are before us; the difficulties arise from our sometimes only seeing the latter part of an attack, or from the convulsive part being so slight as not to attract attention. In epilepsy, which furnishes the type of such fits, we have usually a premonitory sensation, vision, or internal feeling of some kind (aura); a sudden pallor of the face; a scream; complete unconsciousness; a sudden fall, so that the patient often hurts himself; a series of convulsive movements, affecting the eyes, face, head, neck, trunk, and limbs in the general convulsion; sometimes the convulsion is unilateral, either throughout or at the beginning of the attack, sometimes the convulsion is limited to a single limb, or to the facial muscles on one side; when the convulsion is severe and general, the face becomes blue from the respiratory muscles being involved; the patient frequently foams at the mouth, and the froth is often bloody from the tongue having been bitten in the convulsive movements of the tongue and jaws; the convulsion consists of a series of rapid muscular contractions (clonic), although certain groups of muscles may remain for a time firmly contracted and rigid (tonic); the whole body may be wriggled about in the violence of the convulsion. After a few minutes, in ordinary epileptic attacks, the convulsions cease, the lividity begins to disappear, a period of deep unconsciousness with stertorous breathing supervenes, and this merges gradually into a quiet sleep, which may be prolonged for some time even after a short interval of restored consciousness. After the fit the patient seems well, although perhaps complaining of a headache, and of a feeling of confusion. There is no paralysis, or if there be hemiplegia it is usually very slight and quite transient (epileptic hemiplegia). After the fit there is sometimes great excitement, and very erratic conduct with or without violence, and there may be the execution of elaborate automatic actions simulating a deliberate purpose, although quite apart from the controlling consciousness of the individual.

Such are the features of the typical epileptic fit (grand mal); when convulsive attacks, from any cause, approximate to this type they are called "epileptiform"; but nearly every one of the individual features enumerated may be absent, or at least so slight as to escape notice. In particular, there may be no obvious convulsions, a sudden pallor and loss of consciousness being all (petit mal). Allied to this are the so-called "inward fits" of infants, in which we have turning up of the eyes, with apparent unconsciousness, and a momentary rigidity in certain cases. There may, on the other hand, be preservation of consciousness, along with unilateral or localized convulsions; further, the convulsive part of the attack may be over before the patient comes under notice, so that the condition observed resembles simple coma, especially if there be no evidence of struggling, disordered bed-clothes, wetting of the bed, bloody foam, &c. The existence of injury from a fall occurring in connection with a fit rather favors the idea of an epileptic attack or convulsion fit of some kind, as unconsciousness is seldom so suddenly lost in other fits as to prevent some effort at preservation. In apoplectic attacks convulsions occasionally supervene, and in hysteria the discrimination of it from epilepsy is sometimes impossible; indeed a complex condition of hysteroepilepsy is recognized by some (notably of late by Charcot).

The presence or absence of the various features referred to as characterizing a typical attack must be noted. If possible, we should notice or ascertain how the convulsion begins, whether with rotation of the head to the shoulder and conjugate deviation of the eyes, with nystagmus, with twitchings of the lips, or with convulsion of the fingers, feet, &c. Occasionally the convulsion is limited to one side, or even to one part; in such cases we must make sure which side is affected, and if consciousness be not lost we may learn from the patient something of his sensations in the affected part, where they began and how they extended. In cases with unilateral convulsions we must try to ascertain whether there was paralysis of the affected side before the fits, or whether it appeared after the convulsion, whether it was transient or whether it persisted for some time. When unconsciousness is not present at the very beginning of a fit, it is important to discover the time at which it appeared, especially in connection with advancing convulsions or sensations spreading up the limbs. It is not always easy to be sure of the preservation of consciousness in a fit; we must trust to the appearance of intelligence of the patient when we speak to him, and to his power of afterwards describing what happened during the fit, who assisted him, &c.

If the fits recur, we should estimate not only their duration but also the length of the intervals; we should likewise notice whether the muscles become quite relaxed during the intermissions, or whether there remains some tonic spasm; any appearance of an exciting cause must be noted in these recurrences.

In connection with such convulsion fits we must ascertain whether the patient has had any attacks before, and at what age they began; epilepsy in its ordinary form usually manifests itself in childhood, or appears about puberty. Any history or evidence of cerebral disease must likewise be searched for; particularly chronic hydrocephalus, cerebral tumors, abscesses, &c. In children we must remember that various forms of apparently slight irritation may cause convulsions; disorders of the stomach from improper food, and diarrhœa are frequent causes of convulsions. In the atrophic and anæmic condition resulting from these or similar causes, we may have convulsions and other symptoms simulating to some extent the course of meningitis; but the history, the diarrhœa and the collapsed fontanelle serve to guide the diagnosis of this spurious hydrocephalus (hydrocephaloid). The irritation of the gums and mouth during the period of dentition, the presence of worms in the intestines, and indeed any thing which is apt to produce pain and feverishness, may give rise, in predisposed subjects, to general convulsions. Children with rickets and laryngismus stridulus are frequently subject to general convulsions. Acute illnesses (fevers, inflammations of the lungs, and meningitis) sometimes begin, especially in children, with a fit of this kind, and whooping cough is particularly apt to be thus complicated in its course; in hydrocephalus acutus, convulsions commonly supervene at some stage of the illness. In the course of scarlatina, convulsions may be due to the supervention of renal disease. Various poisons are well known to give rise to convulsions. In adults, when there is no history of typical epilepsy, we must consider whether the fits may be due to intemperance and chronic alcoholism, or to syphilis or to Bright's disease. A sudden outburst of convulsions may be the form in which patients so affected may first be laid aside. Other forms of cerebral tumor, as well as the syphilitic, may, however, declare themselves in this way. Renal disease may likewise surprise a patient thus who has scarcely ever regarded himself as ill; but usually there has been some history of dropsy, of recent scarlatina, or some indication of serious disease. The urinary examination is important in such cases; but we must remember that convulsion fits from any cause, are often associated with temporary albuminuria; the microscopic examination, by revealing fatty casts and epithelium, may here guide us in recognizing a chronic form of the disease.

Cerebral embolism and thrombosis, certain forms of apoplexy, and senile degenerative changes in the brain, sometimes reveal themselves by convulsions.

In women during pregnancy and the puerperal state we are apt to have convulsions, depending apparently on irritation, from distension or otherwise, of the uterus, and on the presence of albumen in the urine with all that this signifies. Other forms of irritation propagated from the sexual organs may likewise be mentioned, as causing convulsions; and in particular the premature or unnatural excitement produced by masturbation; ordinary sexual intercourse may determine the occurrence of a fit in those predisposed to such attacks.

Hysterical Fits assume such a variety of forms that the leading features, or rather the commoner ones, only can be noticed. As a rule, consciousness is not abolished, although there may be changes in this respect, and unconsciousness may be simulated; occasionally, indeed, consciousness may seem to be really suppressed. This test, therefore, although important, is by no means absolute; on the other hand, the preservation of consciousness in unusual forms of epilepsy must also be remembered. The emotional disturbance in hysteria is perhaps the most important feature; it is practically confined to the female sex; the rising of a ball in the throat (globus), sobbing, sighing, laughing, crying, and even screaming are quite common. Along with these manifestations there may be tossing about and great agitation, so that the movements may bear a superficial resemblance to those of epileptic convulsions, but we can usually detect that they are to some extent under the control of the will if the patient is dealt with firmly.

In other cases the movements only amount to a general shaking of the body or limbs, or to quivering of the facial muscles when the patient is doing her best to control herself. Swoonings and brief periods of simple unconsciousness constitute at times the only manifestations of hysteria.

The determining causes of such seizures often supply important information; quarrels, disappointments in love, excitement, vexation, &c., may be named as among the more obvious of these. Disturbance of the sexual organs and functions (disordered menstruation, amenorrhœa, change of life, &c.) are likewise important. In debility from long-continued and exhausting diseases hysterical tendencies may show themselves in patients who had hitherto been able to control such manifestations, so that these attacks may form one of the features of grave disease or of impending death.

Plastic Rigidity, as found in catalepsy, is closely allied to hysterical fits; in a slight form it may, indeed, be noticed occasionally during such seizures. In its most typical manifestations the limbs and also the neck and trunk may be retained even in the most unnatural positions in which they are placed, or in which they may happen to be when the fit occurs. The arms, for example, may be moulded into various attitudes, and retained in positions not easily maintained by a muscular man, or the head may be bent back and fixed in such a position that the patient remains resting on the back of her head with the body arched, as occurs in certain cases of tetanus. Such a fit may last for a considerable time, or there may be a succession of such fits, with intervals of a natural condition. In grave forms of such seizures the consciousness is obviously involved, but in slighter cases it is preserved. Like hysteria, catalepsy may be said to be almost confined to the female sex.

LOCAL CONVULSIONS have already been referred to as sometimes replacing general convulsions in an epileptic fit ("Jacksonian Epilepsy"), but the spasms which affect the hands and feet of children must be specially mentioned (*carpo-pedal spasms*). The hands and feet are bent in and slightly flexed, and the thumbs are drawn across the palms. This form of spasm is common in infantile convulsions from any cause; it sometimes precedes general convulsions, the spasm coming or going frequently, or being preserved continuously for some time before the general attack comes on. In more favorable cases the nervous affection may never get any further than this local spasm. This affection is often associated with a swollen appearance of the dorsum of the feet and hands, arising in cases of protracted infantile diarrhœa. This spasm may likewise linger between successive attacks of general convulsions, or it may continue for a considerable time after a single fit, without any repetition. Along with this carpo-pedal spasm there may be some tonic contraction of the muscles of the back and of the nape of the neck. Consciousness is not usually lost in this condition.

This state is closely connected with the occurrence of general convulsions, of which it is to be regarded as a warning; but a less serious form of spasm in these situations is described under the name of *Tetany*; the thumbs are the parts most frequently affected, but the feet may also be involved; in a more severe form the muscles of the trunk and of the jaw may become affected, but the rigidity does not begin in this last named situation as in tetanus. The contraction is not usually very painful, but pain may be caused if the attempt be made to overcome the spasm. It usually varies in intensity from time to time, even when a degree of it remains persistently for days. It has a special tendency to recur after intervals of apparently perfect recovery. Although commonest in children it affects adults occasionally especially women during lactation; its frequency appears to be related to climatic influences, and it has been supposed to be connected with rheumatism.

Spasms or Cramps in the legs are common in many persons; they often occur suddenly during the night, without any obvious cause, but their frequent dependence on gastric disorders, acidity, &c., is quite certain. Such cramps are very painful while they last. A more general form of the same thing sometimes presents a resemblance to "Tetany" as just described. In addition to gastric disorder, we must mention diarrhœa and cholera as giving rise to painful cramps; they are also common in connection with childbirth. Spasms in the limbs also occur as already mentioned in connection with cerebral and spinal disease (see p. 171).

Local Spasms in the region of the face and neck likewise demand attention. Such spasms may be tonic—the contraction of the muscle being steady and sustained—or they may be clonic and twitching in character. Some tonic contraction of certain facial muscles is found at times in connection with severe neuralgia; the person's face assumes a fixed appearance, as if he were acting a part (*histrionic spasm*). Similar spasms, usually, however, more limited to isolated muscles, sometimes remain after an attack of facial paralysis.

Permanent contraction of the muscles of the neck, especially of the sterno-mastoid, gives rise to a form of *wry-neck*. This is, perhaps, usually congenital, and resembles club-foot so far. Occasionally, however, it appears about puberty, or even later, especially in females, and is generally classified then as hysterical. In such cases it may persist for years. Deviations of the head may arise from rheumatic affections of the muscles of the neck, or from the influence of cold, giving rise to the common form of "stiff neck" of a passing character. A similar deviation may result from painful glandular enlargements in the neck. Caries of the vertebræ may lead to a lurching over of the head to one side, and disease of the occipito-atlantoid, or axoidal articulations, usually gives rise to a very peculiar fixity of the muscles of the neck, which become affected in this way simply to preserve the patient from the pain due to the least movement of the head.

Convulsive movements or twitchings of the muscles of the face and neck are also common. Those of the *orbicularis palpebrarum* have already been noticed (see Eye, p. 138). Convulsive movements of the facial muscles on one side are sometimes obviously due to local epileptic seizures (*convulsive tic*). Such twitchings are usually not painful, but they may be associated with some painful affection of the fifth nerve.

Twitching of the sterno-mastoid on one side, or more rarely of the trapezius, constitutes a most troublesome nervous affection, which sometimes assumes great violence and prevents sleep. These movements are under the influence of the spinal accessory nerve, as shown by the effect (usually temporary) of its section, they are obviously of centric origin, and depend probably on disease at the root of this nerve. This convulsive wry-neck may persist for years in a violent form, or it may assume a troublesome severity only occasionally.

Bilateral convulsion of the muscles acting on the head is found in the *nodding convulsions* of children, which sometimes proceed to a bending of the whole trunk (eclampsia nutans, salaam convulsions). Such an affection may be symptomatic of cerebral tubercle, although it also occurs as a more independent disease (see also p. 172).

Tonic Spasm affecting the jaw (*trismus*) is usually the earliest manifestation of tetanus and of strychnia poisoning, and so must be watched for during the administration of this medicine. *Tetanus* affects the muscles of the back and abdomen as well as the limbs. When the back is affected, so as to be curved backwards, the form is named "opisthotonos;" when the abdominal muscles are so much involved as to cause a bending forward, "emprosthotonos" is the name employed; "pleurosthotonos" is applied to similar lateral deviations. Tetanus comes under the notice of surgeons in connection with injuries, but it occurs also idiopathically, sometimes from exposure to cold and wet. The distinctions of tetanus from strychnia poisoning must be sought for in detail in the text books; but the tendency to remissions and to exacerbations brought about by irritations of various kinds, constitutes one of the features of poisoning. The early affection of the jaw in tetanus and strychnia poisoning forms a marked contrast with the late development of this symptom in the severe forms of "tetany" already alluded to.

Spasms of deglutition on attempting to swallow, form one of the features of *hydrophobia*. *Spasmodic stricture of the œsophagus* is rare but not unknown. *Spasms of the glottis* as they occur in cases of pertussis, laryngismus stridulus, laryngeal disease, and thoracic tumor are referred to in the section on dyspnœa, &c. (Chapter ix.).

Sudden Paralysis is sometimes spoken of as a "fit" or "stroke." In connection with the occurrence of this we must observe, or try to ascertain, whether the paralysis came on suddenly in its maximum extent, or in a series of successive invasions, or whether the advance was marked by temporary or partial recoveries. The exact manner in which the paralysis occurs should be ascertained, so that we may judge of the rapidity of the attack, and of the parts involved, and by such inquiries we are often able to ascertain the presence or absence of consciousness during the seizure. Tendencies to giddiness, flashes of light, noises in the ears, and unusual disposition to sleep, may be inquired about: the friends of a patient can often give important information on these points if the patient himself be unable to do so. If there be unconsciousness we should try to ascertain at what period it supervened, if it did not form the initial symptom, whether it obviously deepened or lightened after it appeared, whether it was associated with stertorous breathing, and whether the face was flushed or livid at the beginning of the fit, or on the contrary pale and bloodless.

When a patient is deeply unconscious it is not easy to determine the presence of paralysis: but a certain twist in the features, and a difference at the angles of the mouth, often serve to reveal a one-sided paralysis. On lifting or moving the limbs we may be able to discover a distinct difference in the flaccidity of the two sides, and we are often able to observe that any restless movements of the patient are confined to the limbs of the one side. Attention must be directed in the further examination to the state of the heart and blood-vessels (rigid arteries, hypertrophy or valvular disease of the heart, &c.), to the state of the kidneys, and to the previous history of any former attacks. The immediately preceding events are also important, exposure to the sun, the presence of excitement, the facts as to eating and drinking, &c. (See section on Paralysis, p. 166.)

Coma has already been referred to as a frequent accompaniment of paralysis and convulsion. Unconsciousness likewise occurs in simple fainting fits, and forms one of the less common manifestations of hysterical attacks, and of the rare conditions known as catalepsy, mesmeric trance, &c.

But coma may exist apart from such complications. As explained under the section on convulsion and sudden paralysis, it is not always easy to say whether the comatose state is complicated by these: indications for the discrimination are given under these headings, but with regard to paralysis, we have often to wait till the coma passes away before we can judge; with regard to convulsions we may remain in doubt unless there be a repetition of them. Moreover, in a fit, essentially of an epileptic character, the convulsive part may be absent, as already remarked.

Many diseases terminate in coma lasting for some time before death, and coma forms a frequent episode in febrile diseases which are attended with delirium. In such cases we have usually a series of symptoms leading up to the comatose condition, preparing us, as it were, for its occurrence.

When occurring suddenly, apart from any manifestations of nervous disturbance, or when developed rapidly, even in the midst of nervous symptoms, it calls for consideration under the present section. The most striking form of this sudden coma occurs in renal disease, the nervous complication taking the form of uræmic coma instead of convulsion. It may supervene without warning, and after lasting for a variable period of hours or days, it may pass off suddenly and completely without leaving any apparent effects. We must in such cases test the urine with care: it may be worth while even to draw off some with a catheter for the purpose. We should also, if possible, ascertain to what extent urine had been passed for some days before the fit—whether it was deficient in quantity or quality. We inquire also for any history of dropsy, or other evidence of renal disease, dimness of vision, or the like. In renal coma the pupils are usually contracted, or at least not dilated; and the temperature is not elevated: it may even be low. The test for ammonia in the breath, by means of its action on the fumes of a drop or two of strong hydrochloric acid placed on a glass rod, is not very satisfactory: adaptations of Nessler's test solution have likewise been tried, but not with much success.

Very different in most respects from this is the coma found at the violent onset of scarlet fever, measles, and some other specific fevers. The coma in such cases attacks children especially, after a short period of delirium and excitement, in the midst usually of pretty high fever. In such cases the diagnosis is often enveloped in much obscurity, owing to the absence or suppression of the rash, and the true nature of the attack may only appear on the subsequent occurrence of some fever in other inmates of the house.

The whole group of poisons classed as narcotics produce coma or unconsciousness. Of these the commonest and most important is opium. This may cause coma in certain cases when administered even in medicinal doses, especially in renal disease. Extreme contraction of the pupils is an important indication of opium poisoning, although found in other forms of coma due to cerebral disease. Chloroform, chloral, and alcohol must also be remembered: the diagnosis of unconsciousness from alcohol as distinguished from cerebral disease is often difficult: the smell of the breath is important but sometimes misleading, as those who feel ill may have resorted to the use of spirits on that account just before the seizure.

In nearly all cerebral diseases coma plays an important part; it may be associated with convulsions and paralysis, or it may occur alone. It is often due to pressure on the brain from depressed fracture and from hemorrhage, so that in traumatic cases the coma comes on after the injury in a gradual manner. Or the pressure may arise from fluid in the ventricles, from meningitis, or from cerebral or meningeal hemorrhage. Tumors, abscesses, thrombosis, and other forms of disease in the brain often give rise to disturbances manifesting themselves in coma which may be transient, although the cause may be permanent.

TWITCHING OR CHOREIC MOVEMENTS.

Twitching or choreic movements have been mentioned in connection with paralysis, but they also occur independently. The movements are erratic, and are specially developed when the patient attempts to perform definite actions, such as using a spoon,—the limbs refusing to obey accurately the impulse of the will. Even while sitting quietly twitchings in the face and limbs occur, and these are aggravated on attention being directed to the patient. Grimaces, from twitchings of the mouth and eyes, are the commonest forms of the early manifestation of this affection. A good test in chorea consists in getting the patient to hold out a stethoscope at arm's length on the palm of the hand, or to keep the arms steadily at the side while standing or walking, or to keep the tongue protruded for a little time. Speech and even deglutition are affected in the more serious forms. One side is often much more involved than the other, and sometimes is affected alone (hemi-chorea). Complications with paralysis and weakness of mind also occur (see pp. 170 and 177).

Chorea is common in children, especially in girls, but it also occurs about puberty, and during pregnancy, but chiefly in those previously affected. We must have regard to the general state of the children, particularly as to anæmia and constipation. The disease is to some extent hereditary, or at least included in a general family tendency to rheumatic and cardiac affections, which seem to have some affinity with chorea. Not unfrequently we find chorea following cardiac disease due to rheumatism, but occasionally the chorea precedes the rheumatism, and it often occurs independently of it. The heart must be examined in choreic patients: systolic bruits are not uncommon, but many of these pass away and are not due to valvular disease. Scarlatina has also a tendency to develop chorea. Many facts point to the pathological connection of chorea with cerebral embolism and thrombosis. The determining cause is often supposed to be some fright, but this has probably been much exaggerated by the public. When high fever exists with chorea the case assumes a more serious aspect: sometimes the pyrexia is due to rheumatic complications. Local forms of chorea are usually associated with paralysis, and seem to belong to a different form of disease (see Local Spasms, pp. 192, 193).

DELIRIUM.

Delirium is always a sign of nervous disturbance, but it may arise merely from a general affection of the whole economy operating on the nervous system. In high fever, from any cause, and in long protracted febrile states with much debility, delirium is extremely common, so that a certain disturbance of this kind is habitual just before the fatal termination of an illness. The slighter forms of febrile delirium show themselves just as the patient is half asleep, or before he is properly awake; the talking as if in sleep is continued probably in connection with the previous dreams, even when the patient awakes so as to speak to or answer the attendants. In the slighter forms of this "wandering" or "wavering," the patient catches himself up very quickly, and knows that he has introduced the confusion of his dreams into his conversation. In deeper forms of delirium the patient fails to recognize any error, and may go on speaking, or contending, or struggling with the attendants, as if they were the enemies conjured up in his dreams. Although the patient fails to recognize those around, a certain recognition may remain, and may suggest resemblances or reminiscences from an association of ideas which we can sometimes trace. In yet deeper forms of delirium the external world is less recognized, and the patient shouts, screams, or sings, quite irrespective of what the attendants do or say. In these two last forms the patient has often a tendency to rise up and get out of bed, probably with the notion of escaping from something disagreeable. Another form of delirium is characterized by low muttering or by the movement of the lips without much sound, varied at times by a few louder words, but without, as a rule, any great excitement or disturbance. Picking at the bed-clothes, drawing out imaginary threads, and weaving motions with the arms are not uncommon in this state. (Compare p. 45.)

All these forms of delirium are common in the specific fevers and in severe inflammations, very specially in typhus fever and severe scarlatina, in inflammation of the lungs, and in meningitis. The influence of intemperate habits, or of the habitual use of stimulants, is very potent in causing or increasing the delirium of fevers and inflammations, and a mobile nervous system or great mental activity likewise tends in the same direction. Some of these forms of delirium are found in various forms of injury to the skull and disease of the brain, in intoxication from alcohol and chloroform, and in the poisoned state of the system known as uræmia.

Delirium differing considerably from the foregoing is common in delirium tremens. In this disease the patient is affected with delusions and illusions, and is often very suspicious. He is usually full of business of some kind in his delirium, driving horses, hurrying off to the station, &c., and seems to see various objects distinctly, to which he calls attention; he addresses strangers as well-known friends, with whom he has had appointments, and gives long accounts of circumstances and transactions which are essentially imaginary, although mixed up with actual facts and correct names. Sleeplessness and trembling are usually present. The illusions produced by certain medicines, especially hyoscyamus, may be mentioned here.

When delirium is mixed up with unmanageable conduct and violence, we speak of it as Mania, or maniacal delirium. It may be merely an exaggeration of the delirium already described as symptomatic of fevers or of inflammations, &c., but it may arise apart from these as one of the forms of insanity. It appears likewise, occasionally, after epileptic fits, or even in cases essentially of this nature, in which no proper fit is observed (Epileptic Mania). Mania likewise appears after child-birth in various forms (Puerperal Mania), sometimes with its usual violence, but oftener perhaps in the form of melancholia; but even then there is a tendency to deeds of violence, not only as regards the patient herself, but more especially as regards her infant. In its further progress this is apt to tend to dementia. (Compare the sections on Epileptic, Puerperal and other forms of Mania, &c., in Chapter viii.)

VERTIGO.

Vertigo, or giddiness, and a sense of swimming, or of undulating motion, must be considered as to whether the sensation is felt by the person within himself, or whether external objects only seem to whirl or move. We may try the effect of closing the eyes as a test of this. Both forms may occur separately, or they may be combined. A further point of distinction is whether the person is perfectly conscious of the fallacious character of his sensations, preserving his power of reasoning correctly, or whether with the vertigo his whole mind becomes confused. The usual character of the motions experienced is that of whirling round either slowly or quickly; but sometimes the movements seem even more strange, articles appearing to be piled up on the top of each other, or even turned upside down. In slighter forms there is only the sense of heaving up and down, as if on board ship, or on a suspension bridge which sways under our feet.

This symptom appears not unfrequently in connection with slight derangements of the stomach and liver, and may be associated with other evidence of digestive disorders. It may thus appear after alcoholic excesses as well as during the stage of intoxication. The use of tobacco by those unaccustomed to it, or habitual excess in others, may likewise occasion vertigo. Nervous excitement in many forms, anger, fear, and the presence of unaccustomed surroundings, give rise to sensations of this kind, when, as we say, the person does not know "whether he is on his head or his feet."

A form of *Stomachal Vertigo*, of great suddenness and severity, may be recognized in certain cases where there is not much evidence of gastric disorder, the name being derived from the obvious effect of treatment directed to this organ, especially by the use of alkalies, tonics, and nourishing diet. The vertigo in such cases is often very violent, rendering progression quite impossible, and not prevented by closure of the eyes. With this there may be associated the idea of a yawning abyss at the feet, but the patient is usually able to argue correctly as to these illusions. Persons who have had such attacks are liable to their repetition. (*Vertigo a stomacho læso.* Trousseau.)

Vertigo, associated with deafness or noises in the ears, forms a leading feature of *Ménière's disease*, arising from diseases of the labyrinth or semi-circular canals. (See Ear, p. 158.)

Vertigo from cerebral congestion, or in connection with an impending apoplectic attack, usually appears with pain in the head, sickness or nausea, and other cerebral symptoms. Such vertigo may be rendered worse by a full meal, or by dyspeptic disorders, so that we must not at once set down this symptom to the stomach on that account. In a person over fifty affected with vertigo, especially if somewhat persistent, although not very violent, we must be on our guard against apoplectic attacks, particularly if numbness in one side, or other indications of brain disease, are likewise present. Attacks of vertigo in an extreme form are often present in cases of cerebral tumor. Vertigo likewise constitutes a "warning" in some cases of epilepsy, or may be the chief part of an attack of the "petit mal."

Disturbance of the cerebral circulation, indeed, is probably the common cause of vertigo, even when this is brought about by reflex irritation from the stomach. Such disturbances may also arise in feeble persons, or after fevers, &c., on suddenly raising the head. A certain approach to this vertigo is common on getting up for the first time after long confinement to the recumbent posture, or on going out to the street. Vertigo is likewise a common incident in cases of loss of blood and in profuse diarrhœa, or it may appear after these, in the event of the patient rising or sitting up. Occasionally vertigo results from an apparently opposite cause,—the stopping of habitual discharges.

Allied to vertigo from the sudden anæmia due to hemorrhage, is the giddiness observed from more chronic deteriorating causes, overwork, deficient food, prolonged lactation, menorrhagia, leucorrhœa, &c.

The onset of the specific fevers and acute inflammations is often characterized by vertigo, and the state of the system known as uræmia may likewise give rise to this symptom.

A form of vertigo which is liable to be misinterpreted is that which is due to weakness or paresis of the ocular muscles, occurring especially in persons with an abnormal state of the refraction of their eyes. Such paresis, which may not give rise to any obvious squint, is apt to produce some apparent deviation of the objects looked at, and gives rise to erroneous impressions from the unusual force exercised in adjusting the eyes. Vertigo due to such causes ceases when the eyes are closed. (See p. 154.)

SLEEP.

Various disorders in the patient's sleep must be inquired for and noted when present. There may be sleeplessness, or undue tendency to sleep, or the sleep obtained may be disturbed or troubled.

Sleeplessness may be due to accidental disturbances, such as change of residence and unusual surroundings, or removal to hospital, and the like. Again, it may be due to anxiety or unnatural excitement and activity of the mind before withdrawing to rest, and many other similar disturbances;

these operate much more powerfully on some people than others. Pain is a fruitful cause of want of sleep; this pain may be connected with the disease under which a patient labors, or it may be, as it were, accidental,—from an attack of toothache, &c. Dyspnœa and orthopnœa may interfere with sleep, owing to the inability of the patient to lie down or to keep in one position. Patients with serious cardiac and renal disease affected in this way can only obtain brief snatches of sleep, and may be seen nodding off continually into momentary slumbers, as they sit up or lean their heads forward: it may be added of some of these patients that as they are never properly asleep, so they are seldom thoroughly awake.

Highly febrile states are usually adverse to natural sleep: this arises partly from the attendant restlessness and irritability which, instead of getting less with the approach of night, tend rather to increase; the presence of sweating, and the discomfort associated with it when profuse, are apt to aggravate such a condition. In these cases the patient, worn out with restless tossing about during the night, may obtain some sleep about four or five in the morning, as the daily remission of the fever becomes established.

Acute mania is often preceded by a period of sleeplessness, which leads up to it and may seem to determine its occurrence. High fever and delirium combined are very adverse to sleep, and may prevent any sleep for many successive days and nights. The diseases in which it is most marked are pneumonia, typhus, and delirium tremens, but it occurs in a multitude of other diseases. Patients who are intemperate in the use of stimulants, and those also whose minds are usually very actively employed either from their natural disposition or from the character of their occupations, are apt to suffer most in this respect.

Sleeplessness is often an early indication of an impending attack of delirium tremens and one of the most persistent symptoms during its continuance. Chronic sleeplessness may sometimes be attributed to the abuse of alcohol; in such cases the person may sleep in the early part of the night, remaining awake after two or three in the morning. The habitual use of opium, of chloroform inhalations, and of chloral, begun perhaps to procure rest, is very often responsible for the persistence of an aggravated form of sleeplessness which large doses of these drugs may be quite unable to overcome.

A somewhat similar form of sleeplessness, however, may be found in hysterical patients and others troubled with "nervousness" in various forms quite apart from the use of such drugs.

Disturbance of the sleep by a rapid succession of ideas, or by a whirl of incongruous or disagreeable visions, is frequent in the slighter forms of delirium, and it also occurs sometimes in those whose brains are overtaxed. Such sleep may leave the person with a feeling as if he had been more busily employed than while awake, and does not afford any sense of rest. Effects of this kind are sometimes produced by medicinal doses of opium and other sedatives, especially when administered in unsuitable cases or in too small doses. Dreams of terror which overtake the patient whenever he goes off to sleep, and from which he awakes bathed in cold sweat, are common in deep-seated suppurations, disease of the bones, and other serious affections associated with hectic fever. These dreams are sometimes so terrible that the patient struggles against the approach of sleep. Less alarming or at least less persistent forms of this trouble are found in "night mare," produced usually by an undigested meal taken shortly before sleeping. Slighter forms of this disturbed rest are very common in various dyspeptic disorders, and also in functional derangements of the liver.

The "*night terrors*" which cause children to waken up and scream in a scared manner, quite unconscious apparently of the presence of their parents or attendants, depend probably on the vividness of their dreams, which are not dispelled by the sight of well-known faces.

Somnambulism or Night Walking, in its milder forms, is not uncommon in children as a very occasional event, but it continues to occur frequently in some even till adult life is reached: it is commoner in females than in males, and indicates a sensitive or overwrought nervous system.

Undue tendency to sleep is sometimes met with, especially in children, as an early indication of the action of the specific fevers, scarlatina, and enteric fever in particular. It is an important symptom in various head affections, in the later stage of meningitis for example, and in other forms of disease characterized by pressure on the brain. In adults with a tendency to apoplectic attacks, undue sleepiness and an invincible disposition to go to sleep, especially after meals, supply important warnings of an impending attack.

Great tendency to sleep is likewise a feature to be watched for carefully in renal disease, as it frequently indicates the approach of uræmic poisoning, and may be the precursor of convulsions or other serious accidents: in this condition small doses of opium may produce alarming or even fatal effects.

A certain tendency to undue sleepiness occurs in some cases of anæmia, from various causes: a form of this, occurring in children, sometimes simulates hydrocephalus (spurious hydrocephalus, hydrencephaloid). This form of disease is usually associated with diarrhœa; convulsions may supervene and perplex the diagnosis even more. The flattened fontanelle, the previous diarrhœa, and the pallid complexion are important points in the recognition of this condition.

HEADACHE.

In studying cases of headache we must try to separate all merely superficial pains, such as the various forms of neuralgia and toothache, and also the pains due to rheumatic affections of the face or head, and syphilitic periostitis, or affections of the bones. Sources of pain of a deep-seated character also exist in inflammation of the jaw, or of the roots of the teeth, and in inflammations of the tympanum, of the iris, of the eyeball, orbit, &c. In the case of those able to express their sensations we are usually guided aright by their description of the locality of the pain, and by applying the test of pressure; but when we have not this assistance we are often at a loss in cases of this kind.

Apart from these various pains, true headache is found in the early stage of many fevers and serious inflammations: when delirium comes on, the headache disappears. Headaches also occur very frequently in cases of digestive disorder, in various nervous affections, especially in hemicrania or "sick headache," in inflammations, tumors, hemorrhages, and other serious lesions of the brain and its membranes; headache likewise occurs from overwork and prolonged mental strain, or other undue taxing of the brain under unfavorable conditions (as in the case of children over-weighted with studies in close school-rooms), in the poisoned state of the system known as uræmia, and in anæmia from prolonged suckling, leucorrhœa, or other exhausting disorders. The effect of strain on the eyes, from errors in their refraction, must likewise be remembered as a fruitful and potent cause of headache (see p. 155).

In the investigation of headache the presence or absence of pyrexia is most important; when this is ascertained to be really absent by means of careful and repeated thermometrical observations we may separate at once the group of the fevers and many of the internal inflammations. The association of headache with sickness and vomiting is very frequently observed in the most diverse forms of the affection, but a good deal of information may be obtained by a careful scrutiny of the exact connection between the two; in particular, the state of the tongue, the co-existence of nausea with the vomiting, and the occurrence of vomiting without apparent cause, must be taken into consideration. (See Disorders of the Digestive System, Chapter xi.)

The situation of the headache on the one side, or in front, or behind is likewise of diagnostic value in some cases, and the disturbance of the organs of sense, or the paralysis of certain cranial nerves may throw light on the nature and site of the lesion. The existence of vertigo, of noises in the ears, and flashes of light, must likewise be considered. The occurrence of disorders in the cerebral functions, of delirium, excitement, insensibility, with or without paralysis or convulsions, frequently points to certain forms of cerebral disease. Headache associated with some of these symptoms often occurs in renal disease: indeed, headache may form the first indication of impending nervous disturbance in these affections; this may or may not be associated with a notable diminution in the secretion of the urine.

PAIN IN THE BACK.

This symptom, like headache, occurs at the beginning of many of the specific fevers and some of the acute inflammations. It is very specially prominent in the case of small-pox. In rheumatic affections pain in the back is sometimes a very marked feature of the complaint, but the other joints also usually show some indication of pain and swelling. In disease of the spinal cord, and more especially in spinal meningitis, there is often pain in the back, although it may radiate in various directions. Pressure over the various vertebræ, and the effect of heat and cold to the spine, should be tried in such cases. The sense of constriction, as if by a cord, is likewise common in spinal diseases. (See p. 160.)

Pain in the lumbar region is often designated "Lumbago;" such an affection may be rheumatic, gouty, or neuralgic. Many cases, however, carelessly set down as lumbago, are often due to much more serious ailments, especially to disease of the kidney, renal calculus, &c. Affections of the bladder also sometimes give rise to pain in this situation. Pain in the lumbar and sacral region is a very common feature in inflammations, flexions, and various affections of the womb, or other disorders of the female organs. (See Chapter xv.)

Disease of the bones of the spine (with or without incipient abscess) and aneurism of the aorta are frequent sources of severe and intractable pain of a most puzzling character, as the pain may exist for a long time before definite evidence of their presence can be ascertained. Careful search, however, should be made for indications of these diseases, and the possibility of their presence must be remembered in obscure cases.

CHAPTER VII.

THE USE OF ELECTRICAL INSTRUMENTS.[1]

ELECTRICAL instruments are useful in diagnosis, prognosis, and treatment. The varieties of batteries and of galvanic elements employed are very numerous,[2] but two forms of instruments, differing essentially in respect of the kind of electricity they furnish, must be clearly recognized.

I. The GALVANIC current is obtained from a galvanic battery or voltaic pile, consisting of a series of plates or cylinders modified in various ways. Each "element" in the battery consists of a "pair," composed of dissimilar materials, and these are contained in a cell, along with some kind of exciting fluid.

The strength of the current from the battery is regulated by the number of these elements called into play, and the current is received direct from these plates, through wires and handles, without the intervention of any coil or magnet. This form of electricity is called the "Galvanic," "Voltaic," or "Primary Battery current;" also the "Continuous current," or "Constant current."[1]

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[1] In addition to the works on nervous diseases referred to in the two last chapters, the following writers may be referred to specially: Althaus, Tibbits, Poore, Duchenne, and Meyer. Dr. M'Call Anderson's "Clinical Lectures" may be consulted regarding the galvano-puncture of aneurism.

[2] NAMES OF THE PRINCIPAL ELEMENTS used in medical batteries. *Bunsen's:* charcoal and zinc plates, with water or dilute sulphuric acid in contact with the zinc, and this separated by a porous cylinder from strong nitric acid which surrounds the charcoal. *Stöhrer's* modification of Bunsen's: chromic acid is introduced within the charcoal cylinder, and only one fluid—dilute sulphuric acid—is used. Stöhrer's portable continuous current battery consists of charcoal and zinc plates in narrow glasses with dilute sulphuric acid. *Daniell's:* copper and zinc plates with two fluids, separated by a porous earthenware cylinder; a saturated solution of sulphate of copper in dilute sulphuric acid being in contact with the copper plate, and water or dilute sulphuric acid with the zinc. *Smee's:* platinized silver plates and zinc plates, excited by dilute sulphuric acid. *Grove's:* platinum and zinc plates, with strong nitric acid, as described in Bunsen's, in contact with the platinum, and separated by porous earthenware. *Leclanché:* charcoal with peroxide of manganese in a porous cell introduced with a rod of zinc into a solution of chloride of ammonium. *Becker-Muirhead* and *Siemens and Halske* elements are modifications of Daniell's.

II. The FARADIC form of electricity can be derived from two different sources: (1) from a galvanic battery or element, as just described; or (2) from the action of a fixed magnet, usually made in the horse-shoe form. In both cases, however, *the intervention of a coil is absolutely essential.*

In the first of these two forms (*Electro-magnetic, Volta-dynamic instruments*) the current from the cell is passed through the coil, and powerful instantaneous currents are *induced* in the coil at the joining and the breaking of the circuit—these being alternately in opposite directions. (Hence the terms "interrupted" and "induced" current for this form of electricity.) The strength of the current is much intensified by the presence of a piece of soft iron, or a bundle of wires, placed within the centre of the coil; and the strength of these currents is usually regulated by the approximation or removal of the bulk of the coil to or from this central piece of iron which is converted into a magnet so long as a current is being passed through the coil. Sometimes, however, the regulation is effected by means of a copper cylinder which reduces the strength of the current in proportion as it is made to cover the coil or the magnet. A secondary coil is arranged outside of the first, and can be moved over it towards the central magnet or away from it. Currents are "induced" again in this outer coil in opposite directions to those in the inner.

In the second form of Faradic electricity (*Magneto-Electric instruments*), two coils are arranged, in the form of little bobbins which by some mechanical arrangement (such as the turning of a handle) are brought alternately and in rapid succession in front of the two poles of a horse-shoe magnet. There are pieces of soft iron within these bobbin-like coils, and these are magnetized and demagnetized according as they are approximated to or removed from the poles of the magnet: currents similar to those described in the preceding paragraph are developed at each act of magnetizing and demagnetizing.

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[1] The word *constant*, as applied to galvanic currents, differs from "continuous," in implying not merely the absence of interruptions, but also constancy in the strength of the current for definite although for variable periods. Daniell's battery is the only one constant during long operations, but batteries which are tolerably stant for periods of an hour or two meet most of the medical uirements in this respect.

Both of these forms (electro-magnetic and magneto-electric) are to be regarded, for most medical purposes at least, as essentially similar; they are both spoken of as "Faradic," "induced," and "interrupted" currents. These currents are instantaneous and pass alternately in opposite directions; the rapidity of their succession may be judged of by the number of clicks heard during the action of the machine, as these vary with the interruptions. Arrangements are usually provided for obtaining rapidily or slowly interrupted currents by springs and screws in the one form, and by varying the rate of rotation in the other. The currents from the inner and outer coils are employed separately, the former yielding the "primary induced current," and the latter the "secondary induced current." This primary induced current (the "extra current" of physicists) must not be confounded with the primary current from a galvanic battery; the intervention of a coil shows that we have to deal with an *induced* current. Some forms of apparatus allow of the use of these induced currents always in the same direction, the reverse currents being unused.

A third form of electricity (the static) may be named the FRANKLINIC: it is produced by friction: glass plates or cylinders are rotated against cushions, and a patient placed on an insulated stool may be "charged" from these machines, and sparks drawn out from, or passed into, his spine or limbs. This method of electrization is not now much used, it is only mentioned here to prevent any confusion from its omission.

METHODS OF APPLICATION.

The methods of applying electricity as well as the selection of the kind of current, vary with the purpose in view: both currents are often required in diagnostic tests.[1]

I. THE THERMIC AND CHEMICAL EFFECTS of electricity (galvanic cautery and electrolysis) belong more to surgery than medicine, but as the electrolytic treatment of thoracic and other deep-seated aneurisms is now sometimes undertaken by physicians, some details may be given. The constant current from a battery with moderately large plates is used; the number of elements employed should not be great (*e. g.*, six or eight of Stöhrer's hospital battery); the application should be prolonged as steadily as possible for half an hour to an hour and a half; occasionally one part of the operation is carried out with less or more elements, according to the effect produced; the point of the needle inserted into the aneurism should, if possible, just reach the blood current; the needle thus inserted should be insulated except for about half an inch at its point, so as to prevent the chemical effect on the tissues pierced, and the danger of suppuration from this cause. Instead of one needle two or more may be inserted in connection with the same pole. The needles should be connected with the positive pole. (It may be stated, however, that some prefer the negative pole, and some operators insert needles connected with both poles into the aneurism at the same time, and some use needles without insulation.) The circuit is joined by means of a somewhat large metal plate for the negative pole, covered with a large but thin sponge, wrung out of salt water and applied in the vicinity of the tumor after the skin has been well soaked. The operation may be repeated at intervals of a fortnight or so. On withdrawing the needle a little blood may ooze out, calling for the use of pressure or cold. Perfect rest must be enjoined after the operation.

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[1] As the uses of electricity in diagnosis and treatment are intimately related to each other, a short account is here given of the methods followed in the *treatment* of cases as well as in *diagnosis*. This deviation from the general plan of the book is more willingly introduced, as the student has still some difficulty in obtaining information on this subject.

II. For Acting on Muscles both the galvanic and Faradic currents are used, and in testing paralyzed muscles for diagnostic purposes we often require to try both of these forms of electricity, as it often happens that muscles respond easily to the constant galvanic current, although they respond only imperfectly, or not at all, to the strongest induced or Faradic currents.

We may act on muscles by stimulating the nerve which supplies them; thus we may act on the muscles of the forearm or hand by currents applied to the nerve in the upper arm. We also sometimes stimulate muscles to contraction in a reflex manner by a current applied at a distance, as when we act on the cheek and cause contraction of the eyelid. As a rule, however, we aim at a more "localized electrization," by applying the poles actually over the muscles which we desire to simulate. The points to be selected are not indifferent; a little practice shows that certain spots give the command of certain muscles; it has been ascertained that these correspond with the points at which the motor nerves enter the muscles in question. These spots have to be learned by experience and observation, and charts or diagrams have been made by Ziemssen and others showing their position as ascertained in actual practice. (Some diagrams are reproduced here from Ziemssen's work to facilitate the use of electrical tests in diagnosis. Those who wish further details as to the face and other parts, may refer to the original work, *Die Electricität in der Medicin*, Berlin, 1857; 4th edition, 1872. See also Dr. Tibbits' *Map of Ziemssen's Motor Points;* Althaus's *Medical Electricity*, 3d edition, 1873; and Brunelli, *Album illustré representant la Topographie Névro-musculaire*. Paris, 1872.) The poles should be applied by means of wet sponges, the skin also being well moistened. With the Faradic battery simple water suffices; with the galvanic battery it is better to use always salt water for this purpose. Except in the case of the small muscles of the face and hand large handles (one inch in diameter) and sponges answer best; when small electrodes are used they may be covered

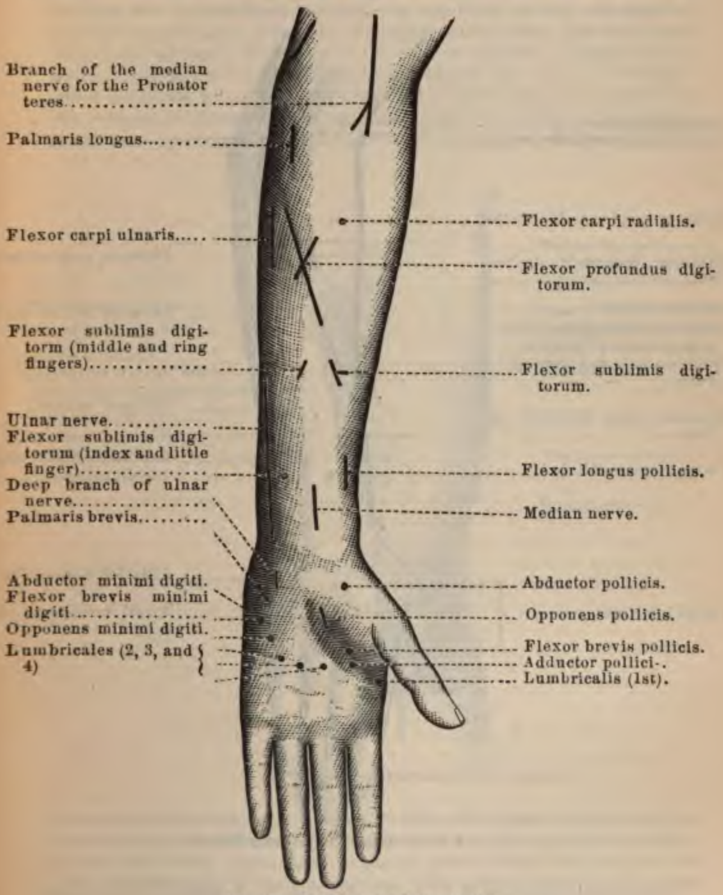
Branch of the median nerve for the Pronator teres
Palmaris longus
Flexor carpi ulnaris
Flexor sublimis digitorm (middle and ring fingers)
Ulnar nerve.
Flexor sublimis digitorum (index and little finger)
Deep branch of ulnar nerve
Palmaris brevis
Abductor minimi digiti.
Flexor brevis minimi digiti
Opponens minimi digiti.
Lumbricales (2, 3, and 4)
Flexor carpi radialis.
Flexor profundus digitorum.
Flexor sublimis digitorum.
Flexor longus pollicis.
Median nerve.
Abductor pollicis.
Opponens pollicis.
Flexor brevis pollicis.
Adductor pollici-.
Lumbricalis (1st).

Fig. 23.—Ziemssen's Motor Points.

with moistened chamois leather instead of sponges. With the *Faradic current* the two handles, armed with the sponges, should be held near each other; the one should be placed on the spot which controls the muscle, and the other dabbed over the surface operated upon; or if preferred, both may be lifted whenever the muscle contracts; it serves no good purpose to tetanize the muscles by a prolonged contraction such as would occur if the action were not interrupted in this way. The strength of the current is of great importance; we ought, therefore, to have an instrument capable of being nicely graduated as to its strength, and also as to the rapidity of its intermission; it is desirable, also, to have one which leaves both hands free for the manipulations of the operation. It is well to try the force of the current on ourselves before beginning (on the muscles of the thumb for example), so that we may see if it is

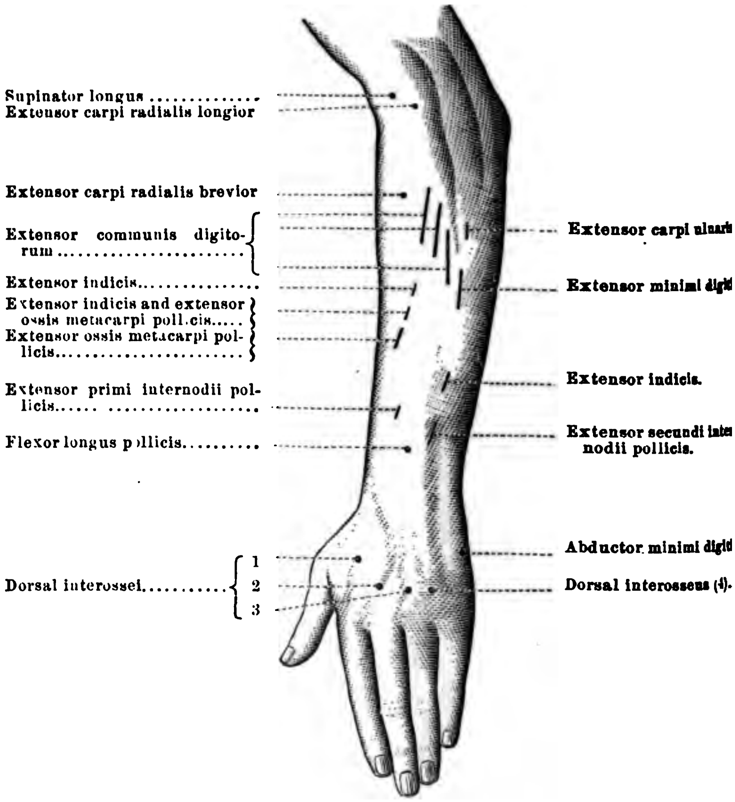
Supinator longus
Extensor carpi radialis longior
Extensor carpi radialis brevior
Extensor communis digitorum
Extensor indicis
Extensor indicis and extensor ossis metacarpi pollicis
Extensor ossis metacarpi pollicis
Extensor primi internodii pollicis
Flexor longus pollicis
Dorsal interossei
1
2
3
Extensor carpi ulnaris
Extensor minimi digiti
Extensor indicis.
Extensor secundi internodii pollicis.
Abductor minimi digiti
Dorsal interosseus (4).

Fig. 24.—Ziemssen's Motor Points.

strong enough to cause contraction and not so strong as to be painful. If such a force fails to act on the paralyzed muscles, we should gradually increase the strength. Slowly interrupted currents from the primary coil are preferred by Duchenne for producing muscular contractions. We aim at using the least strength sufficient for the purpose; this avoids pain and produces a more natural action of the muscles. Sometimes we have to use such strong currents as to cause severe pain, but this is comparatively rare and indicates something seriously wrong in the nerves or muscles. Occasionally no response at all takes place to the strongest currents. It is sometimes desirable to measure accurately the difference of strength in the currents required for calling the muscles into play on the paralyzed side, as compared with the sound side, or at one part of the illness as compared with another. This difference is estimated by the graduated scale usually attached to the movable coil or magnet in an induction apparatus. Special precautions are required to secure uniformity in the comparison, such as are described in using the galvanic current in this process of testing. (See p. 217.)

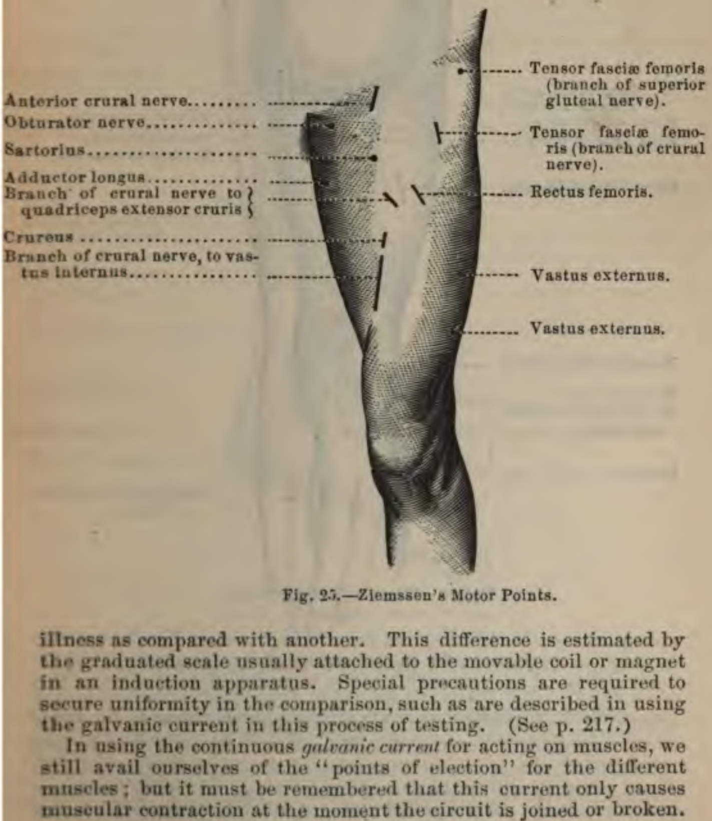
Anterior crural nerve
Obturator nerve
Sartorius
Adductor longus
Branch of crural nerve to quadriceps extensor cruris
Crureus
Branch of crural nerve, to vastus internus
Tensor fasciæ femoris (branch of superior gluteal nerve).
Tensor fasciæ femoris (branch of crural nerve).
Rectus femoris.
Vastus externus.
Vastus externus.

Fig. 25.—Ziemssen's Motor Points.

In using the continuous *galvanic current* for acting on muscles, we still avail ourselves of the "points of election" for the different muscles; but it must be remembered that this current only causes muscular contraction at the moment the circuit is joined or broken.

A current from a constant battery passed for a time steadily through a muscle does not cause it to act after the first contraction; but on withdrawing the handles, another contraction may occur. Hence if we wish to stimulate the muscles to contraction, we require some means of interrupting this continuous current. This may be done by a commutator on the battery, shutting off or putting on the current by a key, or by removing one or both of the sponges. A similar effect is produced more gradually and gently by gliding the sponge along; in this way the current is joined and broken at the various parts passed over in the course of its movement ("labile currents"). A very powerful action is produced by reversing the currents, by means of the commutator, and less suddenly by reversing the relative position of the sponges. The relative position of the two poles is not a matter of much consequence in acting on the muscles, except in the estimation of the force required in different parts, as will be explained immediately. It is not necessary to have the two poles applied close together in acting on muscles

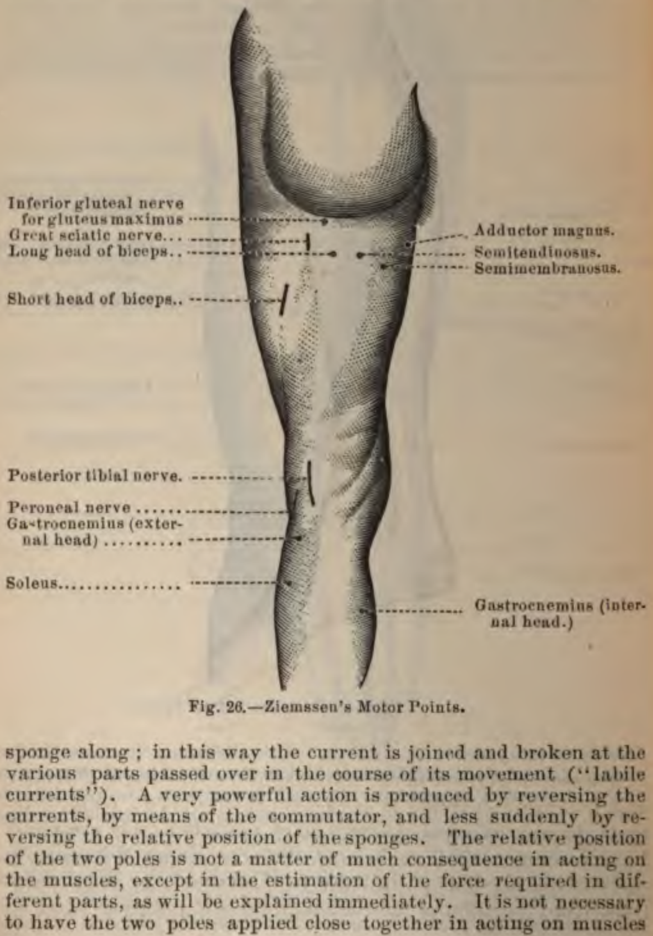

Fig. 26.—Ziemssen's Motor Points.

with the galvanic current; indeed, it is usually better to have them at a distance, one of them being placed on the point known to command the muscle, and the other perhaps on the nerve trunk higher up. It is very necessary to have the sponges moistened with salt water, and the skin over the parts operated on should also be well soaked.

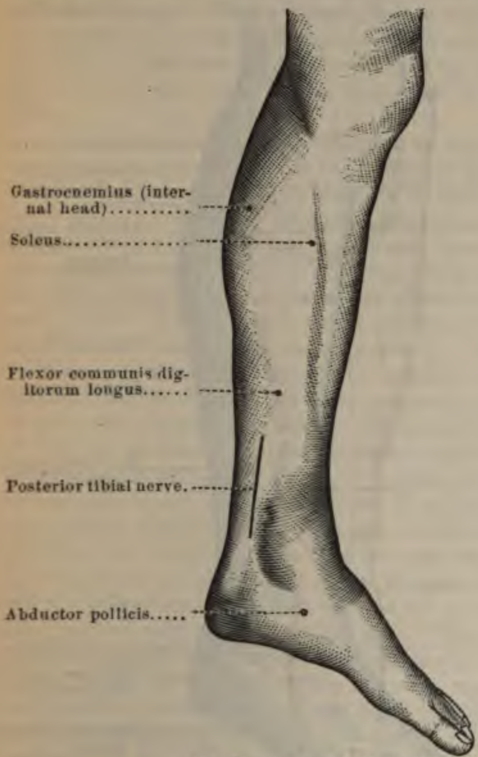
Gastrocnemius (internal head)..........
Soleus................
Flexor communis digitorum longus......
Posterior tibial nerve.
Abductor pollicis.....

Fig. 27.—Ziemssen's Motor Points.

A great difference in the response of muscles to the Faradic and Galvanic currents is occasionally observed; feeble currents from a galvanic battery may act when the strongest Faradic currents fail to do so. This is observed in certain cases of paralysis from injuries to the nerves, in facial paralysis from peripheral causes, in infantile paralysis, and in certain cases of lead palsy; this constitutes a point of great importance in the diagnosis, prognosis, and treatment.

But further, paralyzed muscles sometimes respond with preternatural readiness to very weak currents; *i. e.*, they respond to currents which would not cause any noticeable action in healthy muscles (two or four elements). This occurs in the diseases named above, and especially in facial paralysis. This peculiarity is well brought out in such cases by applying the poles of an *induction* battery to the sides of

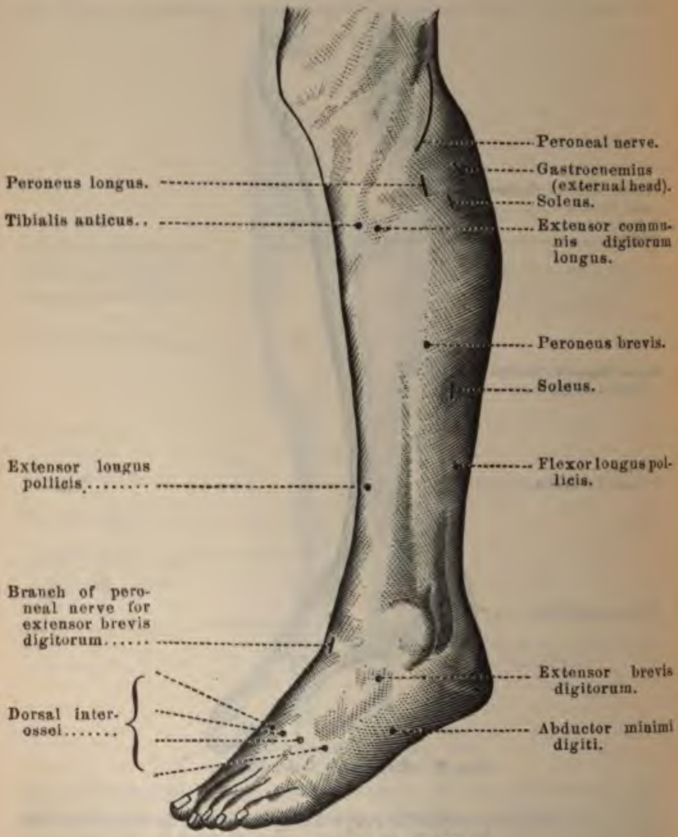
Peroneal nerve.
Peroneus longus.
Gastrocnemius (external head).
Soleus.
Tibialis anticus..
Extensor communis digitorum longus.
Peroneus brevis.
Soleus.
Extensor longus pollicis........
Flexor longus pollicis.
Branch of peroneal nerve for extensor brevis digitorum......
Extensor brevis digitorum.
Dorsal interossei.......
Abductor minimi digiti.

Fig. 28.—Ziemssen's Motor Points.

the mouth, when the mouth is at once drawn to the sound side; on applying now the poles of a *constant* battery to the same parts, lifting and replacing them occasionally, it will be seen that the paralyzed muscles draw the mouth to their side during the stimulation. All gradations of these reactions are found in different cases of facial paralysis and at different stages. This unusually ready response to the constant current generally diminishes with the improved contractility of the muscles to the induced current which takes place in favorable cases under treatment or in the course of time.

The explanation of this difference in the behavior of the paralyzed muscles under the two different forms of electrical stimulation is not yet clear, but it is in some way connected with the instantaneous or extremely brief character of the induction currents. It has been found that by interrupting the constant current *very rapidly*, while applied to such muscles, it also ceases to have any effect on the muscles in such cases. The reaction described above has been named by Erb the "reaction of degeneration." (See also p. 223.)

When an accurate comparative estimate of the muscular contractility is desired, we must proceed in such a way as to get a fair comparison, and we avail ourselves, if possible, of the sound muscles on the opposite side for this purpose. Moreover, in using the galvanic current we must consider which pole is applied to the nerve or muscle, and we must also notice whether the contraction occurs on breaking or joining the circuit. In judging of any change in the response of the muscles to electricity, we must consider whether we are operating on the nerve trunk or on the muscles, as the reaction may differ considerably in these two cases. In carrying out the comparison one pole is placed on some indifferent part of the body (the sternum, nape of the neck, or patella, for example), and the other is applied successively to corresponding spots on the two sides of the body. We notice then the difference in the readiness or force of the contraction, and we note how much more, or how much less, is the strength required for the paralyzed muscles as compared with the others. In using the galvanic current we vary the experiment by using the positive and the negative pole alternately over the part to be excited, as the results are not identical.

In connection with this subject electrical authorities sometimes use formulæ which require explanation, especially as the words represented by the letters in some books are partly German, and very confusing to readers in other countries.

An = Anode (the positive pole, sometimes marked +).
Ka = Cathode (the negative pole, marked —).
S = Schliessung, *i. e.*, closing of the circuit.
O = Oeffnung, *i. e.*, opening or breaking of the circuit.
Z = Zuckung, *i. e.*, contraction or twitch of the muscle.
Z′ = The accent indicates an intensification.
z = The small letter indicates a feeble contraction.
Te = Indicates Tetanic contraction.

The symbols are combined thus as in the formula for the action of strong currents, or

"Highest grade," Ka S Te, Ka O z, An S Z, An O z.

These four formulæ are read thus: (1) On the closure of the current the cathode produces tetanic contraction: (2) on opening the current it produces feeble contraction: (3) on closing the current the anode produces lively contraction: and (4) also on opening the circuit.

"Lowest grade," Ka S Z.
"Intermediate grade," Ka S Z′, An S z and An O z. (Erb.)

In connection with aural electricity the symbol Kl. means Klang (sound), and the musical symbols < crescendo or increasing loudness, and > diminuendo or diminishing loudness, are also used.

With the induction apparatus we use the currents from the secondary coil in this test, and the trial is conducted on the same principles.

III. ACTION ON SENSORY NERVES. When applying Faradic electricity to stimulate muscles, we aim at doing so without pain, or at least with a minimum of action on the sensory nerves; hence the directions to use the lowest efficient strength, to select the current from the primary coil, to use slow interruptions, to have large sponges moistened with simple water for electrodes, to apply these near together, and to make the application just long enough to cause muscular contraction, removing and re-applying the electrodes frequently.

In acting on sensory nerves *with the Faradic current* these directions are all reversed: the skin should be left dry or dusted over with violet powder, metal handles or charcoal electrodes without sponges are used, or even a wire brush is employed for one of the poles: strong currents from the secondary coil and rapid intermissions are preferred, and the brush may be moved up and down over as large an area as we choose. Such applications are sometimes employed with advantage in cases of anæsthesia, to rouse the sensory nerves, and they are sometimes of use in diagnosis. Insensibility to this irritation, or diminished electrical sensibility as it is called, is a striking feature in certain cases of hysterical paralysis and anæsthesia, and in some other affections. While testing the muscles in such cases we can usually guess by the behavior of the patients whether or not they feel the current to a normal or usual extent, and we may subsequently apply the test more efficiently as just described.

The wire brush is also used by some for its counter irritant effect and its reflex action. Brushing over the spine in certain spinal affections, brushing the cheek and larynx in facial paralysis and hysterical aphonia, and applying very strong currents in neuralgia (electric moxa) are methods sometimes practised, but all of them are painful and must be used with great caution. This treatment has also some influence over the vascular system, and it sometimes improves the temperature of a cold limb.

The *Galvanic current* is occasionally felt to be painful in cases which are insensible to strong induced currents (hysterical paralysis), so that the form of electricity employed in testing should always be noted. Charcoal electrodes suit very well in applying this test to the skin. The sensation experienced from the constant current differs from that felt on using the interrupted current: the latter gives rise to a tingling feeling, the former produces a burning or stinging sensation. On galvanizing the spine with a moderate current we sometimes detect, while applying the moist sponges, that there are one or two tender spots over certain vertebræ, *i. e.*, spots specially sensitive to this current. These spots often agree exactly with the spots discovered to be tender to the touch, but sometimes this test reveals tender parts more delicately than pressure or the hot sponge. Care must be taken that the various parts of the skin are equally moist in applying this test, and the presssure of the electrode also must be made quite equal in the different parts before we conclude that this sensitiveness really exists.

IV. Applied for Muscular Rheumatism and myalgia, both kinds of electricity are occasionally employed. The induced currents are used in such cases either with wet sponges for the stimulation of the muscles, or with the wire brush. When the constant current is employed, and it is usually to be preferred, moderate currents are used, and the poles are made to glide gently over the painful surface. (Lumbago, stiff-neck, muscular pleurodynia.)

V. For Neuralgia, induced currents of great strength applied with the wire brush (electric moxa) are used by some, but as they are very painful and as counter-irritation in less painful forms often serves the same purpose, this method is seldom to be recommended.

The constant galvanic current, on the other hand, can be applied in such cases with little or no discomfort, and is often most serviceable. The current should be strong enough to be felt, but should not cause pain (6—10 elements for the face, 8—20 for the limbs): the current should be passed without any interruption, the sponges being held steadily without any movement or shaking. Difference of opinion exists as to the direction in which the current should be applied; a balance of opinion exists in favor of (1) a *descending* current (*i. e.*, a current from the nerve centres towards the periphery), and (2) of applying the positive pole over the painful part, without regard to the direction of the current (polar method). These two methods are not incompatible. The skin should be well moistened with salt water for applications of this kind, and as pressure with the electrodes is often painful, the effect can be increased by having the spots selected for the application dressed with salt water dressings for an hour or two before the current is applied. The duration of the application should be considerable, 5, 10, or 20 minutes at a time: but on the face the duration is much less, as giddiness is apt to be produced in this situation, and on its occurrence we must stop the application, at least for a few minutes. In applying and removing the electrodes, or increasing or diminishing the strength of the current, we aim at doing so with as little "shock" as possible; this is done either by gradually increasing or relaxing the pressure of the electrodes on the parts, or by adding and removing the additional elements gradually.

For cases of neuralgia, a battery with relatively large plates and small chemical action should be selected, and the patient should remain at rest for a time after the application, especially in cases of sciatica. The sittings should be repeated daily if possible.

VI. THE NERVOUS CENTRES can be acted on by the constant current applied to the head and spine, and patients often experience giddiness, flashes of light, and a metallic taste in the mouth when the head or the upper part of the spine or neck is operated on. *For the head* weak currents must always be used, not more than about ten elements at the most, and the applications must be short (half a minute to three minutes), and they must be stopped on the occurrence of giddiness. The electrodes are placed sometimes on each side of the head, on the temples or mastoid processes, or one on the nape of the neck and the other on the brow or on one of the mastoid processes. No rule can be given as to the direction of the current in such applications.

For the spinal cord a larger number of elements may be used and the time prolonged to fifteen minutes or more. The part operated on is determined by the nature of the case. As a rule, in spinal cases descending currents are preferred, but in locomotor ataxy the ascending current seems to give better results. The sponges and skin must be well moistened with salt water, and the electrodes should be held very steadily to avoid all shocks as much as possible. Sometimes one pole is applied to the spine and the other to the region of the plexuses or nerve trunks; or one to the region of the plexus and the other to the main nerve in the limb, as this stimulation may have an indirect action on the cord.

Galvanism to the spinal cord and brain should as a rule be avoided in all acute or recent cases. Faradization is not to be applied to the brain or spinal cord.

The sympathetic in the neck may be acted on, it is supposed, by placing one of the electrodes over its upper, middle, or lower cervical ganglion, and the other on the cervical region of the spine, at its lower part, or on the supra-sternal notch. Certainly some very curious results follow such applications, flashes of light, giddiness, and bilateral convulsive movements; but it is not quite certain that all this is due to stimulation of the sympathetic, as other important nerves are in the same region.

Operations of this kind must be carried out with great caution; only weak currents should be used, and short applications, as in the case of the brain.

Galvanization of the sympathetic is recommended in many obscure cerebral and spinal affections for its supposed influence on the nutrition of these great nervous centres.

VII. FOR IMPROVING THE NUTRITION, the circulation, and the temperature of a part, any form of electricity which improves the state of the muscles and nerves may be recommended, but the constant current has usually a more marked influence in lessening the coldness of a limb so often complained of in the atrophic forms of paralysis. Certainly this kind of electricity affects the circulation, and it is possibly in this way that it produces a beneficial influence on the nutrition of the tissue of the nerves, the brain, and the spinal cord.

VIII. SPECIAL ORGANS require some special arrangements for the application of electricity. The *Eye* is acted on when we seek to affect the optic nerve by applying (say) the positive pole of a constant battery to the forehead, to the mastoid process, or to the nape of the neck, and gliding the other pole along the angles of the orbit, or by passing the current through the temples. The ocular muscles may also be galvanized or faradized by bringing a small electrode into their vicinity. *Ear* is galvanized or faradized by filling the meatus with salt water, and introducing an insulated electrode into the fluid while the head is held down sideways, the other pole being held by the patient in the hand of the opposite side. The same care must be exercised in using such methods as in operating on the brain. Applications to the sympathetic in the neck are sometimes made for these organs. Specially shaped and insulated electrodes are used for direct application to the *laryngeal* muscles. Stimulation of the *phrenic nerve for the excitation of the respiration* sometimes saves life in chloroform poisoning, and its use is indicated in some other forms of asphyxia. Metallic buttons as electrodes, with fine moist sponges or leather coverings are applied on either side of the neck, over the lower end of the scalenus muscle, on the outer border of the sterno-mastoid, and this muscle should be pressed a little inwards; the head and shoulders should be fixed by an assistant, and expiration may have to be assisted by pressure on the abdominal walls. The duration of one application (*i. e.*, for each contraction) should not be more than twenty seconds. The current should be from an induction apparatus, and should be strong enough to cause contraction of the muscles of the operator's thumb; if this does not succeed in causing an inspiratory gasp, stronger currents may be tried, as the excitability sometimes diminishes rapidly in asphyxia. If induced currents fail to act, the continuous current has been recommended as a last resource. The *abdominal muscles* and even the *bowels* and *bladder* and *uterus* may be acted on to some extent from without, the poles being applied to various parts of the abdomen and back. For the rectum, a more efficient plan is to introduce an insulated electrode within the bowel, and to apply the other to the abdominal parietes. Both forms of electricity may be used in this way. The bladder is likewise sometimes acted on by means of an insulated electrode introduced into its cavity, the other being applied within the rectum or above the pubes. If the continuous current be used, the generation of gas from the decomposition of the urine may lead to annoyance if the electrode be within the bladder. For incontinence of urine a strong current from a continuous battery (from as many elements as can be borne, fifty or more of Daniell's or Smee's) may be passed upwards, the negative pole being applied to the perineum just behind the scrotum, and the positive to the dorsal or lower cervical region of the spine. The uterus is sometimes acted on in the same way as the bladder. In *impotence* the testicles, the muscles of the penis, or the mucous membrane of the glans may be acted on by the constant or by the interrupted current, according as the error seems to be in the secreting power of the testicle, the defective state of the erector muscles, or the sensitiveness of the glans.

DIAGNOSTIC SIGNIFICANCE OF ELECTRICAL TESTS.

Contractility of the muscles to the induced current may remain but little impaired in cerebral paralysis, in rheumatic paralysis (apart from affections of the facial nerve), in hysterical paralysis, in paralysis of the extensor muscles of the fingers and wrists from pressure on the arm (arising from the use of splints and crutches, or from lying on it during sleep), in locomotor ataxy, in general paralysis, in pseudo-hypertrophic muscular paralysis, in wasting palsy, and in certain cases of paraplegia from spinal lesions. Any of the above forms of paralysis, however, may exist so long, and may lead to such disuse of the muscles that wasting and destruction of the muscular tissues proceed to such an extent that they no longer respond to this stimulus, or do so only feebly. This is especially noticed in advancing cases of wasting palsy, where the response, of course, is diminished in proportion to the actual wasting, although preserved in the remaining portion of muscle. While this contractility to the induced current exists unimpaired, we infer that there is no serious lesion of the muscles themselves, of the nerve trunk supplying them, or of the nervous centre at its point of junction with the nerves in question.

Abolition or diminution of the contractility to the induced current occurs in paralysis from such serious lesions of the nerves as results from wounds, or from compression of the nerve trunk by tumor, or exostosis, or certain exudations. In the case of the facial nerve an exudation in the osseous canal may give rise to serious compression of this kind, or caries may lead to the destruction of the nerve. In infantile paralysis also, and in other forms of spinal disease with destruction of the cord at the roots of the nerves, or of the cells connected with them in the anterior cornua, this contractility is lost or diminished. Lead palsy is also usually characterized by this peculiarity. The loss or diminution of the muscular contractility to the induced current occurs with great rapidity in all the above cases, and usually exists from the very time the paralysis becomes distinctly declared, differing therein from the loss of contractility which is developed slowly in connection with mere disuse or atrophy. (See next section also.)

Preservation of contractility to galvanic current, and loss of contractility to induced current. This is commonly observed in the cases just noticed in the previous section, at least in their earlier stages. It frequently happens in cases of facial paralysis especially, and also in infantile paralysis and lead palsy, that the response to the continuous current is even livelier on the paralyzed than on the sound side. This reaction usually concurs with some lesion of the nerve trunk or of the nerve root involved. (Erb's reaction of degeneration.)

Loss of muscular contractility to both currents is found in advanced paralysis, from any cause, which has led to the destruction of the muscular tissue or to its fatty degeneration; such destruction may be inferred from this test. Especially does this occur in old spinal paralysis with atrophy; in bad cases of infantile atrophic paralysis, in the last stage of pseudo-hypertrophic muscular paralysis and wasting palsy, and also in lead paralysis. It occurs rapidly also in serious mechanical lesions of the nerve trunks from wounds and injuries.

CHAPTER VIII.

INSANITY.[1]

BEFORE considering the forms of insanity, it is desirable that the meaning of certain terms, which are of constant use in describing mental disorders, should be clearly understood. These are—

ILLUSIONS, HALLUCINATIONS, AND DELUSIONS.—Illusion and Hallucination have reference only to disordered perceptions. Both, separately or together, may exist without insanity. In order to the occurrence of an Illusion, a *real* impression must be produced on the sensorium; but this impression appears in consciousness very different from the actual fact. The impression in most cases comes from without, and is transmitted through one or other of the senses (by far the most frequently through those of hearing and sight); but it may spring from one of the internal organs. On the other hand, an Hallucination arises when no impression has been produced on any of the senses, and it is equally independent of visceral sensations. It is entirely a new creation due to an abnormal condition of the sensorium itself. The varying morbid states of this great centre, or of these great centres of sensation, seem in the consciousness of the individual to be impressions that have come in natural course from the organs of special or general sensation. Briefly expressed, Illusions are objective in relation to the sensorium, whereas Hallucinations are subjective. Thus, if a human voice be heard by one when others hear only the tolling of a bell, that is an Illusion; but should it be heard when there is no sound of any kind, that is an Hallucination: and so with the other senses. It is sometimes difficult to distinguish between these two forms of morbid perception, especially when they relate to general sensation. Whatever their origin, should the patient's reason still enable him to discard them as false and unsound, he is sane in relation to them;

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[1] The following writers may be consulted with advantage: Bucknill and Tuke, Blandford, Maudsley, Griesinger, and Ireland.

and this frequently happens with illusions, though seldom with hallucinations. If he cannot be convinced of their unreality he is very generally insane, but not always, as early training, peculiar religious views, and other special circumstances may account for the apparent mental unsoundness.

Delusion, strictly regarded, pertains exclusively to the highest mental functions, and has no direct connection with sensation in any form. A man who asserts he is ten thousand years old, or that he is the Almighty, labors, therefore, under Delusion proper. But though the term is occasionally employed in this restricted sense, to distinguish it from those already described, it is also commonly used generically to include them all. It may thus be correctly applied to either Illusions or Hallucinations, if they are the result of disease, and are not corrected by reason. In a court of law, as a matter of expediency, it is advisable to avoid the latter terms, and to designate all morbid ideas of lunatics as "*insane* delusions;" the word delusion *by itself* being often popularly used to describe a mere unfounded belief.

THE CHIEF FORMS OF INSANITY, according to the best established classification, are Mania, Melancholia, Monomania, Dementia, and Idiocy. Mania implies considerable general excitement, which is usually accompanied by incoherence of ideas, delusions, and violent conduct; but there are varieties of mania without incoherence or distinct delusions. In Melancholia there is mental depression with delusion generally limited to one or to a small number of subjects. There is also simple melancholy without delusion. In Monomania there is no depression, but generally exaltation or perversion of feeling; delusion is restricted to one or (much more commonly) to a small number of subjects, all of the same character; but the intellect, though often wonderfully clear and acute in other directions, is not altogether free outside the morbid circle. In Dementia the powers of the mind, previously of average vigor, are enfeebled or destroyed. In Idiocy the original mental development has fallen far short of the normal standard, either through a congenital cause or one occurring in early childhood. Imbecility is this state in a minor degree.

Premonitory mental symptoms almost always precede an attack of any of the acquired forms of insanity. These are to be looked for in disturbance of the emotional powers rather than in an abnormal state of the intellect,—the latter condition being subsequent to the former. There is usually a preliminary period of depression, and this is often seen even where the fully pronounced derangement is a state of excitement. The patient has a vague feeling of discomfort, of mental weariness and pain. There is unwonted irritability; trifles that would formerly be unheeded, now fret and worry; those most loved and bound by the closest ties of kindred are regarded with suspicion, jealousy, and aversion; a feeling of baseless apprehension, with sometimes a painful anticipation of insanity, are experienced: unusual vacillation of purpose may be a feature; and the sufferer, particularly in the premonitory stage of melancholia, may likewise have a weariness of the world, and a longing for death. Such feelings and dispositions in various combinations form the foundation of morbid sentiment on which delusion, in its varied forms, is based. In some cases of mania, however, there is no preliminary depression and the initiatory stage is one of gradually increasing excitement.

MANIA.—In *acute mania* the preliminary stage of depression with irritability, should it exist at all, is not generally of long duration. About the period when it is giving place to excitement there is occasionally a general susceptibility of the nervous system, characterized by exceeding sensitiveness to sharp and loud noises, and to bright light, and also by a disposition to sudden and violent starting of the legs and even the whole frame, especially when about to fall asleep. Some people are, however, subject to similar startings in a minor degree from slight causes, such as derangement of the digestive system, and many epileptics suffer from them in the intervals between the fits.

The mental excitement may show itself very gradually, or it may be quite sudden in its onset. The disorder of the intellect occurs in degrees varying from scarcely noticeable rambling in conversation to complete incoherence. Illusions and hallucinations, particularly of sight, as well as delusions proper, are very common, though mania may exist without any of them. A distinguishing feature of the morbid ideas is their evanescence; they are not fixed, even though the same kind of fancies may recur from time to time. Besides the intellectual disturbance, there is general restlessness and impatience, a hurry, a confusion, and an unusual disposition to action. Some patients are in a happy, joyous mood; others are angry and irritable; not a few alternate between these states. The conduct is often violent and disgusting: shouting, singing, gesticulating, quarrelling and fighting, tearing clothes, smearing the person and bedroom with feces, and other filthy actions. Outrageous conduct is often first manifested during the night. It is to be observed that both delusions and actions are stamped by the character of the prevailing morbid emotion.

From the very commencement of the illness sleep is almost always deficient in amount, and is occasionally absent altogether; or, what is more common, it is obtained for half an hour or an hour, now and again, the patient awakening in no respect improved. Terrifying dreams often disturb these brief snatches of sleep. The appetite, though frequently considerably impaired in the early stage of the disorder, is usually good when it is fully developed, and, indeed, is sometimes abnormally keen. But, notwithstanding the large quantities of food consumed, nutrition is not well maintained, and many patients distinctly fall off in condition. The tongue is moist and clean in many cases, but may be furred and yellow, in which case the breath will probably also be unpleasant. The bowels are generally confined, and the stools are apt to be offensive, but occasionally a tendency to diarrhœa is seen. Thirst is seldom present. The urine is commonly diminished in quantity, increased in specific gravity, of acid reaction, with an excess of phosphates; but occasionally it is neutral or even alkaline, and the amount may be normal. Excitement of the sexual instinct, which is not rare, may show itself in masturbation and indecent exposure of the person. Menstruation is usually altogether or in a great measure suppressed. The menses generally return coincidently with recovery, but their appearance does not always herald the advent of convalescence; and, on the other hand, mental health may be restored while they continue in abeyance. In the majority, the skin is somewhat harsh and dry, but it is quite common to find it soft and moist; its secretions are often disagreeable in odor. Should the patient's exertions be violent, the general temperature may be temporarily elevated, but ordinarily it is little if at all above the average. Increased heat of head, especially of the vertex, is often noticeable. In a few cases there is excessive salivary secretion. The pulse, as a general rule, is from eighty to ninety in frequency, and of diminished volume; but there are many exceptions, some being a few beats above and others below that range. In the early stage the conjunctivæ will often be found somewhat injected and yellowish, but this is not common when the excitement is fully established; the aspect is then frequently bright and glistening.

Acute mania occurs occasionally in a more asthenic form than that just described. The physical symptoms are indicative of greater debility: the pulse is weak and quick, the pupils wide, the face pale, and there is often distinct anæmia. The psychical disturbance is also more uniformly high. In short, this form holds a middle position between the sthenic and the one next to be considered; and there is a gradation of cases connecting all three.

The variety now before us corresponds in some respects with severe delirium, and is hence known as *Acute delirious mania*. The incoherence in this state is complete; the patient talks or shouts in fragmentary disconnected sentences, and the excitement is very high. There are no definite delusions, the mental disorder being apparently too great for formulated thought of any kind, but in some cases indications of transitory hallucinations and illusions are observable in the midst of the ravings. Such patients are generally violent and destructive and of dirty habits, but their acts differ from those of ordinary acute mania in partaking more of blind fury, with less distinct consciousness in the agents. The physical symptoms are proportionately intensified. The pulse is very quick and weak, the conjunctivæ are injected, and the pupils are often smaller than the normal, the skin is parched and hot, the tongue is dry, tending to brown, the appetite is in abeyance, and there is usually a sickening odor from the breath, a degree of thirst is common, and there is an almost total absence of sleep. There is a high mortality in this condition, but should the tendency to death from exhaustion be overcome, the patients usually make excellent and speedy recoveries from their mental disorder.

Mania transitoria is a variety which, as its name implies, passes away quickly—even in a few hours, or at longest in a day or two. The symptoms are those of the most acute form of sthenic mania. The seizure occurs suddenly, and is most frequently met with as a result of mental shock or of intoxicating liquor in persons who are of the "insane temperament"—who in their ordinary health are excitable, nervous, odd in their opinions, and peculiar in their general conduct—this condition being usually the fruit of heredity. It is also apt to show itself in individuals who have had sunstroke or whose heads have been injured (possibly many years previously), after a slight excess in alcohol, or from a moral cause, such as sudden and great provocation. When due to alcohol this is the "mania a potu," properly so called.

Chronic mania may be considered as established when—the symptoms of the acute stage having somewhat subsided, after some months' duration—the delusive ideas are more definitely formed than at first, the incoherence is still considerable, though somewhat less, and the excitement is not so constant but more paroxysmal in its character. At this period, illusions and hallucinations, especially of hearing, are commonly present; but one or more of the other senses also are frequently involved in the same patient. The bodily condition is now generally good. This is the state of a large proportion of the inmates of asylums. It may last for many years in much the same form; but, what is more common, by slow degrees the mind becomes more and more enfeebled till at length its powers are irretrievably lost in the ruin of complete dementia.

RELATION OF VARIOUS DISEASES AND FUNCTIONAL DISORDERS TO INSANITY.—In susceptible persons certain states of the system, both physiological and pathological, are sometimes the immediate causes of insanity, particularly of mania; and in many cases they also impart a distinctive character to the mental symptoms. Thus there is an *hysterical mania* in which the strange imaginations and peculiar deceptions characteristic of hysteria are associated with excitement, slight incoherence, and erotic displays, as well as generally with some of the physical symptoms of the disease, such as the passing of large quantities of pale urine, and the "globus hystericus." This form would seem to be frequently dependent on irregularities in menstruation.

At the establishment of the menstrual function excitement with delusions and a disposition to impulsive violence may appear, constituting the "mania of puberty." This generally passes away in a few days or weeks, and seldom continues after menstruation is regular. At the same period of life, in both sexes, instead of mania a moral perversity occasionally arises, manifesting itself by a suddenly acquired disposition to lying, cheating, stealing, and the like—this state being the result of disease, though very often not so considered. It is much more likely to be of long duration than the maniacal condition, and too often gradually involves the mind generally, passing ultimately into incurable insanity.

Disorder of the Uterus and Ovaries, at any time during the years of their functional activity, especially when there is amenorrhœa, is not an uncommon cause of other varieties of insanity. The distinctive delusions that spring up then have often reference to these organs or to their functions: thus the sufferers may fancy that they give birth to children, or that their persons are violated while asleep. Nymphomania may arise from the same source; the particular feature in it being a disposition on the part of the patient to make indecent advances to the other sex, and even to make shameful exposure of the person. A distinction has been drawn between this state, which is regarded as due to the general disturbance of the nervous system from a peripheral irritation in the sexual organs, and that named Erotomania, in which the organs of generation are apparently healthy, and the morbid action is believed to be entirely in the brain. The mental symptoms are really alike in both; though it has been held by some that, as opposed to nymphomania, the language and conduct in erotomania are pure, and do not greatly transgress propriety. In the male sex a condition corresponding in the character of the acts and in the general psychical features is known as Satyriasis. It is, however, to be borne in mind that delusions connected with the organs of generation in both sexes may exist with perfect propriety of conduct, and also that amenorrhœa is a common symptom in insanity due to other causes.

At the close of menstruation one of the many troubles that are apt to arise is mental disorder. It occasionally assumes a maniacal character, but much more frequently the form is melancholia, with delusions and a disposition to suicide. It has been named "climacteric insanity."

It is thought by some that *excessive venereal indulgence*, especially in the newly married, may suffice to overthrow the mental powers in susceptible persons, inducing what has been designated sexual mania; but other direct causes probably always combine with it in the production of the insanity, and there is nothing distinctive in the symptoms.

The vice of masturbation, in both sexes, sometimes induces an intractable form of mental derangement. Early symptoms springing from the vile habit are an unwonted shyness and an evasive look, irresolution of character, and a disposition to be alone. By-and-by a general feeling of fear and suspicion of others arises, with sulkiness of temper; then come hallucinations, such as that the victims are acted on through the walls by electricity, that their food is poisoned, that they are tormented by evil spirits, &c.; great religious fervor is common, especially in women. In most cases the intellect gradually becomes weak, as is obvious by the obtuse expression, and after an indefinite period the unfortunates sink into dementia. General nervous symptoms, such as palpitations and feeling of sinking at the heart, are usually associated from the beginning with the psychical disturbance. Should the masturbation be stopped before the intellect is much impaired, mental health may be restored; but once insanity has been distinctly established, recovery is the exception rather than the rule, as the vice is then seldom mastered.

The influence exerted on the mind of woman by the sexual system is evinced in other ways than those mentioned. The majority of women are more susceptible and impressible, and are sometimes very irritable, during the flow of the menses. *During healthy pregnancy*, also, cravings for extraordinary articles of diet are very common. These are usually innocent enough, but not always, as when a woman, overcome by the sight of the brawny arm of a baker who worked opposite her dwelling, compelled her husband to offer him money to allow her to take "one bite" out of it.

Mental disease occasionally appears during utero-gestation, and is apparently dependent on it; this is known as the *insanity of pregnancy*. It is not common, and is more prone to occur at a late than an early period of gestation. Though mania and monomania are both met with, melancholia is the usual form, refusal of food and a disposition to suicide being sometimes marked features. The majority of such patients recover soon after delivery, but a large proportion continue insane.

In severe labor, during the passage of the head through the os internum, and also through the vaginal orifice, it occasionally happens that the patient falls into a state of semiconscious delirium, lasting for a few minutes. The writer has seen a mild attack of mania arise during severe labor resulting from contracted pelvis, which passed away in two days after delivery. This is a rare event.

The most important of all this group of disorders is that which occurs within two or three weeks after delivery, and bears the name of *Puerperal mania*. The fourth or fifth day is the most common time for the appearance of the symptoms, though it may be at an earlier as well as at a later period. Sometimes the attack is very sudden, but generally for a day or two previously the patients are unusually excitable, sleep but little, complain of pain and a feeling of constriction in the head, and have often optical troubles, such as flashes of light and double vision. The pulse is also quick and the skin may be hot. When the insanity is fully developed the symptoms both physical and mental are all of an acute type, and the condition may even amount to delirious mania; but, fortunately, this is somewhat exceptional. It is a feature of the psychical state that the language used is often filthy and obscene. Aversion to husband and baby are common, but by no means constant, symptoms. Under the influence of this feeling, mothers have in many instances destroyed their infants. Cases are also met with, beginning within a week after childbirth, in which the condition would be more correctly designated acute melancholia than acute mania. Early in the disease, as a rule, both the lochial discharge and the mammary secretion are arrested; but in mild cases the latter, and even both, may continue to flow, though in reduced quantity. Occasionally the urine is found to be albuminous. It is well to remember that there is also sometimes metritis or endo-metritis, as these are apt to be overlooked through the greater prominence of the mental symptoms.

There is yet another important variety connected with the puerperal state—*the insanity of lactation*. It occurs after some months' nursing, or immediately after the weaning of the infant, and is due to the drain, through the mammary glands, having proved too much for a feeble or susceptible frame. As might be expected, the patients are weak and usually anæmic. Melancholia is the type of disorder that is most frequently developed, but other forms are occasionally seen. In this variety also, a disposition to destroy the infant is not uncommon; besides this, a tendency to suicide is sometimes manifested. Ex-ophthalmic goitre and functional cardiac murmur have been noticed in a few cases, particularly where the mental derangement presented maniacal features.

Alcoholic Insanity.—As already stated, "transitory mania may be at least directly induced by alcohol; but besides this and the much more common disease, Delirium tremens (see p. 199), there are other disorders resulting from the same powerful agent, which have yet to be noticed. (1) Habits of intoxication, along with the ordinary symptoms of chronic alcoholism, often induce a state of mind characterized by gloomy suspicion and hallucinations of hearing. This condition has prompted to homicide as well as to suicide in a number of cases. (2) Excesses in alcohol may cause mania or melancholia of an ordinary acute kind, except that the delusions partake of the delirium tremens character, and that the attacks themselves are of shorter duration. Though cases of this kind are occasionally seen, they must be regarded as rare. (3) Progressive dementia, accompanied by a form of general paralysis, is a rather common result of prolonged drunken habits. It not infrequently occurs in women who have been long addicted to secret tippling. The symptoms closely resemble those of ordinary general paralysis, and in some cases the disorders can scarcely be distinguished from each other. The diagnosis will be considered in connection with general paralysis. (4) There remains the condition known as dipsomania or oinomania. The craving for drink in this state is insatiable, and no consideration whatever deters the victim from seeking its gratification. Three varieties have been distinguished—the acute, the chronic, and the periodic. The acute, which is rare, has been noticed after hemorrhage in the puerperal state, in recovery from fevers, after excessive venereal indulgences, and in some forms of dyspepsia. It often passes away in a few days, and shows no disposition to return. The chronic is the form that exists in the habitual drunkard. In him the craving for alcoholic stimulants is constant, and is often strongest in the morning. He experiences a sensation of sinking at the stomach, with a feeling of mental depression amounting even to misery when not under their influence. Great moral depravity is generally a marked feature of character; and the writer has observed that in women this is usually associated with much pretence or show of religion. The periodic variety is not common. It occurs in paroxysms of exceeding severity, ordinarily with intervals of some months between them. All these varieties, but particularly the last one, are not infrequently the outcome of the "insane temperament."

The poison of syphilis in the constitution may give rise to different forms of associated disorder of the brain and mind. Thus, after a prodromal period of irritability, slowness of mental action, and occasional confusion of ideas, accompanied by shooting pains in the limbs and numbness of the head, there may be one or more convulsive fits, followed by mania or melancholia; or instead of either of these forms of mental derangement, the symptoms mentioned may be succeeded by a hysterical condition which rapidly declines into dementia more or less complete. Sometimes the premonitory stage is succeeded by a state which bears considerable likeness to general paralysis. There may even be grandiose delusions likewise, though this is not common. The defects in articulation and the paresis of the voluntary muscles generally are very similar in both cases. In the syphilitic form there is both greater rapidity and irregularity in the progress of the symptoms. The sensory phenomena are likewise much more marked, such as pains in the limbs, numbness, and formication; and these, as well as the motor symptoms, are more apt to be unilateral at an early stage of the disease. The retinæ are not so uniformly affected: and should there be irregularity of the pupils, it will probably be found that some of the ocular muscles are also paralyzed. The convulsive seizures are more disposed to be partial, both as regards the implication of consciousness and the muscles involved, than in the case of general paralysis, and the attacks are also more frequently followed by paralysis of the convulsed members; this may or may not be persistent. The evidences of constitutional syphilis in nodes, enlarged glands, cutaneous eruptions, &c., with a history of contagion, will of course materially aid the diagnosis.

Besides a real there is also a spurious syphilitic insanity, which bears the name of *Syphilophobia*. The distinctive feature of this disorder is an intense fear in the mind of the sufferer that syphilis has been acquired, every trifling papule being regarded as convincing evidence of its presence. In other respects the mental state is that of acute melancholia. It is most frequently met with in persons of high moral tone who have once or twice fallen into irregularity of conduct.

Epileptic Insanity.—When epilepsy has continued for some years it induces mental defect, and this may occur much sooner if the fits are frequent, but if they are at long intervals the mind may remain unaffected. In some cases the *petit mal* would appear to exert a more baneful influence on the mental powers than the full convulsive seizure; but this, though asserted by some, is not always the case, as the writer has seen patients subject to the latter form in whom dementia rapidly supervened, and others who had suffered from epileptic vertigo for years, at short intervals, and still retained considerable mental vigor. Irritability of temper and weakness of memory are the first indications of the mind being involved, but in course of time all its powers are implicated, and ultimately the wreck is complete. But instead of an uniform, progressive degeneration, it often happens that, after a single seizure or a number in succession, an acute maniacal attack occurs, in which there is generally manifested a disposition to violence, and occasionally also to suicide in the same patient. The mania may pass away in a few minutes or in an hour or two, and in any case seldom lasts longer than four or five days, though it is apt to return on the recurrence of the fits. The last feature, however, is very irregular, and in illustration, the writer may allude to a patient under his care who had an attack of epileptic mania about five years ago, and has continued free from it since, while there has been no abatement of the convulsive seizures. Though the mental disorders generally follows the convulsions, it occasionally precedes them, and in some cases would seem to take their place, the entire paroxysm being apparently mental. In some instances epileptics fall into an automatic state without having had a convulsive attack, and then perform actions which, though usually irregular and destructive, may be definite and correct in themselves, but only wrong as to time or place—the patients being quite unconscious, and incredulous when told of their conduct on their recovery. This state is generally very brief, lasting only for seconds or minutes, but it may continue for half an hour, seldom longer.

The poison of *rheumatism and gout* in the system may induce mental disorder which sometimes amounts to insanity. Such attacks are often of a metastatic character, the joint affection being in abeyance during the continuance of the mania, which is the usual form of derangement in these circumstances. The attack commonly passes away within three or four weeks. A similar event may occur in the course of *asthma*. For example, a person who had been a martyr to the spasmodic form of the disease for nearly twenty years, rather suddenly became maniacal; the asthma then entirely disappeared, and did not trouble her during the six weeks that the insanity lasted; but when the latter subsided, the asthma returned in all its former oppressiveness. The writer has also seen the *poison of lead* induce an attack of mental derangement, which continued for a few days; there were also convulsions in the case; the characteristic blue line on the gums was present.

Phthisical Insanity.—In the later stages of phthisis pulmonalis mania is occasional developed. The symptoms are generally very acute, even attaining the severity of those of delirious mania; the attack often terminates in fatal exhaustion. In an earlier stage of the same disease, or of general tuberculosis, Dr. Clouston has pointed out that a morbid mental condition of a different character is sometimes present. It is characterized by unfounded suspicion and irritability, with occasional bursts of excitement or fits of depression. This mental state is, however, not so common as an opposite one in tubercular disease of the lungs, in which the patients are sanguine and unduly hopeful, even when their illness is going on to a fatal issue. But the psychical condition in the latter case is not insanity.

The feeling of sinking and general discomfort experienced by those habituated to the *use of opium*, in whatever form and way it be taken, when they are not under its influence, occasionally attains to such a degree of intensity that the condition may even amount to insanity. The unfortunate sufferers who have arrived at this stage, after the effect of the drug has died away, are wretched, miserable, and may even be suicidally disposed. The writer has known it necessary to commit such an one to an asylum; but this is quite exceptional.

The excitability which is an ordinary symptom of *Graves's* or *Basedow's disease* (Exophthalmic goitre), may increase and be accompanied by incoherence and violence, so that mania is established. The attack commonly subsides in a few days.

Tape-worm in the intestinal canal may induce mania through the action of the peripheral irritation on the brain, just as it occasionally gives rise to epilepsy.

Blows or falls on the head are not infrequently followed by insanity. The form varies: mania and dementia are both met with, as also a combination of the two. The condition is hopeful or otherwise, according to the amount of injury sustained by the brain.

When distinct insanity is produced by *sunstroke*, or follows *typhus fever* or other of the *exanthemata*, although mania may be the primary character, dementia generally soon ensues; or the insanity may be of this form from the first. The prognosis in these cases is generally unfavorable. But this is to be distinguished from a condition of mental excitement of moderate severity, accompanied by hallucinations of hearing and sight, which occasionally arises somewhat suddenly in an advanced stage of these diseases, and also in pneumonia, but usually passes away in a day or two, or even sooner. This has been lately described as a form of insanity; but observation of such cases would rather lead the writer to designate it as an acute form of delirium, symptomatic of the associated disease, though not always of a state of collapse, as was believed by Dr. H. Weber, who first directed attention to this variety of mental disorder.

The catalogue of physical diseases or causes, on which insanity may be more or less dependent, has not yet been exhausted. In fact it would seem that a morbid condition of any organ, in persons of weak, susceptible, nervous systems, may so disturb the functions of the brain that mental derangement may be the result. Thus it has been developed in connection with intestinal, hepatic, and vesical diseases. There is little uniformity in the symptoms of the insanity which arises in this way; and it would rather appear that the character of the mental disturbance is more dependent on the general condition of the system as to strength or weakness, and on the nature of the hereditary bias which so commonly exists, than on the special organ whose morbid state may have been the exciting cause of the cerebro-mental disorder. At the same time it may be said generally that disease in the abdominal organs, and especially in the liver, is more apt to be associated with melancholia than with any other form. But in considering the association of disease in these organs with insanity it is always to be borne in mind that this may be altogether accidental, or that their morbid state may be due to that impaired nutrition of the central nervous system on which the insanity itself depends.

Impulsive Insanity.—A tendency to act under insane impulses is a feature of the acute forms of mania and melancholia, particularly the former. Besides this, however, there are varieties in which this disposition is the chief, and occasionally almost the only evidence of mental derangement. Generally there is only one kind of impulse in the same patient, but there may be more than one, and the one may alternate with the other. The suicidal and the homicidal are the most common and the most important, and bear the names of Suicidal and Homicidal mania, although this last form is rare, and recently its very existence has been questioned by some authorities.

Similar morbid impulses to steal and to set fire to houses, &c., are known respectively as Kleptomania and Pyromania. But homicidal and other criminal acts are much more frequently the result of delusions, and more particularly of "voices" that may seem to the victims to come from Heaven, requiring implicit obedience from them as a sacred duty.

The impulsive tendency is not infrequently manifested in persons respecting whom no suspicion of mental defect is entertained by others, in prompting to break large sheets of glass, to interrupt public speakers in their addresses, and to other actions which the patients know full well to be wrong, and struggle against with all their might, and fortunately almost always successfully. In some who were troubled in this way the writer has found other indications of derangement in the nervous system—one which was much complained of being a "springy" feeling in the feet, as if they were made of india-rubber. This sensation was experienced every few steps in walking, and when severe passed up to the head, producing a giddy feeling. Another troublesome symptom was involuntary starting of the limbs in going to sleep. In all these patients the cause appeared to be mental strain.

Sometimes the moral powers of the mind are affected in a marked manner, while the intellectual are but little disturbed. This condition has been called *Moral insanity.* Those in whom it is seen have usually a strong hereditary bias towards mental disorder, and may have previously suffered from it in one of its more complete forms—particularly mania. Pure cases of this variety are rare: still they are met with occasionally. The symptoms are lying, stealing, cheating, mischief-making of all kinds, and a disposition to violence—these being opposed to the patient's former character. In one characteristic case, long under observation, besides the state just described, there was further evidence of morbid change in the brain in partial hemiplegia. This designation—Moral insanity—is objectionable, and should be avoided by medical witnesses in courts of law: if required to define the condition, it is better to speak of "partial insanity."

MELANCHOLIA stands next in importance to mania as a leading form of insanity. It is often met with as *Simple Melancholy*, without delusion or distinct intellectual derangement of any kind. The patient is aware, and admits that there is no real cause for the mental depression, but is quite unable to shake it off. A sense of the ludicrous may exist along with this habitual state of feeling. A disposition to suicide is frequently present. It will usually be found that the general health is weak; and in women there is often anæmia and frequently also leucorrhœa.

Hypochondriasis passes into melancholia when the more or less imaginary troubles that affect the patient amount to actual delusion, out of which he cannot be reasoned. In illustration of this, a patient complained for a long time of uneasiness, and sometimes of severe pains in the abdomen, for which there was no very obvious cause; then she became miserable, and declared that the devil himself was in her belly. Her first condition could not be pronounced to be insanity, but when the delusion arose, the proof of it was clear. In hypochondriasis the depression of feeling is seldom so great as in melancholia; and in the latter, besides delusions, a disposition to suicide is more marked than in the former.

Acute melancholia may be suddenly caused by a severe mental shock, but it is much more frequently preceded by a long preliminary stage of depression. When the disorder is fully developed the unhappy feeling may attain to one of despair. The wretched sufferer may utter loud lamentations, tear his hair, strike his breast, and even make desperate attempts at self-destruction. It is seldom, however, that the condition is so bad as this; but there are all degrees between simple melancholy and the state just described. The attitude and the expression betoken the mental frame. In some, the arms hang heavily by the side, the eyes are turned downwards towards one point, and are almost statue-like in the fixity of their gaze, and the angles of the mouth are depressed; or—the morbid feeling being more acute—the hands are clenched, the features are tense, and the sufferer moves about in restless agitation. The latter variety is less common than the former. Notwithstanding their misery, melancholics seldom shed tears; their sorrow is too deep for that. In most cases they are decidedly worse in the morning, just after awaking from sleep. Though in general sleep is broken and much disturbed by unhappy dreams, it is by no means so deficient in amount as is the case in acute mania. The pulse is weak and not accelerated; the skin is clammy and cold, and the lips have a purplish tinge; the tongue is apt to be furred, and is sometimes indented at the edges; the bowels are generally constipated, and the breath offensive, and the stools are occasionally deficient in bile. There is usually amenorrhœa in women. Refusal of food is common, and may arise from delusion, from suicidal intent, or from real derangement of the digestive organs. Precordial anxiety is not uncommon: and in some cases of intermittent melancholia the paroxysm begins with this sensation, which seems to the patient to extend upwards to the head, and then the gloom and mental pain are experienced. In some cases—fortunately rather rare—the physical symptoms correspond closely with those of delirious mania, and, as in it also, the mortality is high.

There is a form of melancholia known as *Melancholy with stupor*, or *Melancholia attonita*. It has two varieties, depending on whether the element of stupor or that of profound melancholy prevails. The symptoms are much alike in both. The patients stand in the one position, or continue the same motion, heedless of what passes around; they require to be fed, and often resist artificial feeding; and they are frequently inattentive to the calls of nature. The circulation is languid and the skin is cold and bluish. The varieties are best distinguished by the aspect. In the melancholic the features are tense, and the countenance, as a whole, betrays fear or anguish so deep that the mental powers are overwhelmed; whereas in the other, while a certain amount of depression is evident, stupidity predominates in the expression. It often happens in this form of mental disorder that serious disease in other organs, particularly the lungs, may be insidiously progressing though manifesting very indistinct symptoms.

Acute melancholia, though often recovered from in a few weeks or months, may become chronic, or the chronic form may supervene on acute mania, in which case there is usually more or less dementia along with it. Whatever its origin, melancholia, if confirmed, has a tendency to pass into dementia, though that frequently does not occur for many years. The chronic forms are not unfrequently associated with disease in one or other of the abdominal organs, on which they may be partially dependent. The ordinary forms are incident to middle or declining life, though it is not rare to meet with them in young people. Melancholy with stupor on the other hand, is much more a disease of youth than of age.

CIRCULAR INSANITY (*Folie circulaire* of the French) is a form in which mania and melancholia alternate, sometimes with intervals of a few days, or a week or two, of apparent sanity. The alternating condition often partakes more of dementia than of melancholia. It is very frequently incurable.

MONOMANIA is generally used to signify partial insanity of the intellect. The term is misleading if it be regarded as meaning mental unsoundness on one subject, the judgment and the emotional powers in other respects being absolutely free. However limited the delusive idea, the natural tone of the mind is always altered,—elevated or depressed, expanded or contracted,—and there is also a morbid exaggeration of self-feeling. At the same time cases are not rare where the intellect is wonderfully sound and vigorous outside the sphere of morbid ideas. Thus, two cousins, men about forty years of age, came under notice at the same time, the one of whom fancied that his penis was once, somehow, tampered with by his fellow-workmen, and also that on several occasions, without his consent, he had been acted on by electrical agents; whilst the other declared that he himself was "a little Christ." On all other subjects they were apparently sensible, intelligent men, with whom one might talk for hours without discovering their morbid fancies, unless one had a clue to then previously. However, the unhealthy state of feeling above referred to was obvious. The delusions of monomania are of endless variety. They may be roughly grouped according to the prevailing morbid sentiment, which, as has already been said, lies at the root and precedes formal delusion. One class, in which there is exaltation of feeling, is characterized by morbid ideas respecting power, wealth, talents, personal appearance, &c. In another class, suspicion being the prevailing sentiment, the patient may probably imagine that there is a plot against his life, that spies dog his footsteps, and that his food is drugged. Prompted by such fancies, lunatics in a number of cases have killed their imaginary persecutors. Hallucinations and illusions, especially those of hearing, besides delusions proper, are common. They are very important should they assume the form of "voices" conveying commands to the patient, and particularly should there be any disposition to obey. This, as previously mentioned, is a frequent source of suicide and homicide in the insane.

Monomania, especially when accompanied by hallucinations of hearing, is an intractable form of insanity. Still, occasional recoveries do take place after it has lasted for several years. In most cases, as time passes, additional delusions spring up, and the morbid circle gradually widens till the intellect is entirely involved. Then there is also incoherence, the mental degeneration having passed into incurable dementia. The general bodily health during this slowly progressive mental decay is usually very good.

General Paralysis, also called "general paresis," and sometimes "paralytic dementia," is a very important and a very fatal form of insanity. It is peculiarly a disease of middle life, seldom occurring under thirty or above sixty years of age. It is at least four times more common among men than among women. Its ordinary duration is from two to three years; but it may terminate fatally in six months, or be protracted for six years or longer. When the disease is developed, in nine cases out of ten there is exaltation of feeling, though this is occasionally preceded by a brief period of depression; and in a few very exceptional cases there is melancholy feeling throughout its whole course. After this brief preliminary stage of depression has passed away, if it existed at all, the patient becomes restless and flighty in his manner, and impatient of control. He spends his money foolishly, and launches forth into wild speculations. Then the characteristic delusions arise. He asserts he is worth millions of money, is as strong as Samson, and is King of the Universe: any or all of these or similar extravagant notions may be entertained. Even in this stage, the defective memory and the inability to follow out any subject of thought, reveal the enfeeblement of intellect; and emotional weakness may also be evident in the aspect, and the tendency to bursts of passion if in any way opposed. At this period there is also sometimes a disposition to indulge to excess in alcohol, and to be indecent in conduct before the opposite sex; occasionally a proclivity to steal is manifested. The delusions usually persist to near the fatal close, or, at least, so long as advancing defect in articulation permits of their being recognized; but even *they* would seem sometimes to be involved in the utter wreck of mind in the final stage. In the earlier period of the disease, maniacal excitement, with destructive tendencies, is very common.

Indications of the paralysis appear in most cases shortly after the onset of the psychical disturbance. The two sets of symptoms may, however, occur simultaneously, and the paralytic may even precede the mental disorder. These indications are first noticeable in tremor of the upper lip, especially when the zygomatici and the elevators of the lips are in action. Certain movements of the tongue are likewise not performed with their natural precision. The patient has thus difficulty in articulating words in which there ares everal labials or liquids—Tolerable, February, Constitutional—for example. The defect seems a thickness or slight stuttering, like that of a person in the first stage of drunkenness; and it may only be observable at this period when the patient is under emotion. It is not usually till after some weeks or even months have elapsed that the muscles of the lower extremities are involved. Then there is observable at first a peculiar cautiousness of gait, with slight uncertainty and unsteadiness, most distinct when about to turn after walking a few paces. The arms are often late of being much implicated, but ultimately they do not escape. As the disease progresses, the articulation becomes more indistinct, the tongue while being put out is projected in a jerky manner, and a fibrillar movement is observed in its substance. All the muscles of the face are involved, and a characteristic hebetude of expression is acquired. Though both sides are generally affected pretty equally, the paralysis occasionally is more pronounced in the muscles of the one side than the other. When the disease is far advanced, the muscles of deglutition and respiration participate in the increasing ruin, and it is not seldom that death occurs from choking by a morsel of ordinary food. In most cases after it has reached its middle stage, epileptiform seizures and attacks of cerebral congestion occur occasionally. The pupils are very generally unequal; in some they are minutely contracted; in exceptional cases they are normal. There is hyperæmia of the retina in the early stage, and neuro-retinitis, quickly passing into atrophy, when the distinctive symptoms of the disease are obvious; there are not many exceptions to this rule. Defect in cutaneous sensibility is not very marked at first, but later its existence is clear; local hyperæsthesiæ may co-exist with it. The muscular sense is also impaired; and electric contractility suffers at an advanced period. When the disease is distinctly progressing, the evening temperature is often from 2° to 4° F. above the normal. Hæmatoma auris not unfrequently occurs along with the more acute symptoms. In a few cases, during the course of the disease, there are remarkable remissions, extending over a number of months, and these may be so complete that a cure may be supposed to have been effected; but unfortunately, with scarcely an exception, there is a relapse, leading ultimately to a fatal issue.

In private practice General Paralysis is very often overlooked in its early stage. In a few exceptional cases the diagnosis is difficult, but in the great majority, when the symptoms are looked at together—for no one by itself is pathognomonic—it is easy, and a mistake should not occur. The following are the leading symptoms, mentioned in their order of importance:—Difficulty in articulating certain words, and tremor of the upper lip; emotional weakness with exaltation (it may be necessary to contradict the patient before these are properly manifested); grandiose delusion; general feebleness of judgment and memory; unsteadiness of gait; inequality of pupils; hyperæmia of retina, followed by atrophy of optic disk. Sometimes the intense self-feeling, as well as the exaltation, come out most distinctly in writing, and it may therefore be advisable to ask the patient to write his views on any subject in which he may seem to be particularly interested.

The disease for which it is most apt to be mistaken is a form of paralytic dementia due to long-continued excesses in alcohol; and certainly it is occasionally very difficult to distinguish between them. This is not surprising when it is remembered that habits of drunkenness are sometimes associated with over-indulgence in venery in the production of real general paralysis. The distinguishing features of the alcoholic variety are:—Stupidity with depression of feeling, rather than emotional exaltation with intellectual weakness and extravagant delusions; belief in present or past hallucinations of the alcoholic type; no inequality or other abnormal state of pupils; defects in articulation partaking of a drawl as well as of a stutter; absence of retinal change except congestion at first, which rapidly subsides; the whole aspect one of obtuseness rather than of exaltation combined with feebleness. Still, cases do occur now and again when the paralytic and mental symptoms are very much alike in both forms, and there may be nothing but a history of habitual drunkenness, and of a former attack or attacks of delirium tremens, with normal state of the pupils and only slight congestion of the fundus of the eye, on which to base a rather doubtful diagnosis of alcoholic dementia.

Monomania occasionally bears a degree of resemblance to general paralysis in its early stage. The delusions may be equally extravagant in both, but in the former there is less variability in their character; the memory is good, the judgment in other respects may not be obviously impaired, and altogether there is greater mental vigor. Besides, the paresis of the muscles of articulation, emotional weakness, &c., are not present.

Locomotor ataxy in its ordinary form can scarcely be mistaken for the disease under consideration. But the pathological changes in the cord found in ataxy would seem occasionally to extend to the medulla oblongata and higher parts of the brain, inducing defective articulation and mental disorder. Delusions of grandeur are not a common feature of insanity arising thus.

It will suffice merely to mention that the mental and physical degradation, which are often found in epilepsy of long standing, occasionally bears a general resemblance to a somewhat advanced stage of general paralysis, in which, as already stated, epileptiform seizures are common; an inquiry into the history, besides a study of the symptoms, should at once establish the diagnosis.

DEMENTIA is usually the sequel to other forms of mental disorder. Mania occasionally passes into it after a few months, but this is not usual till a much longer time has elapsed. Melancholia and partial intellectual insanity, as a rule, reach dementia at a considerably later period than mania does: often not for many years. The condition ranges in degree from slight enfeeblement, characterized by dulness of apprehension, weakness of memory, and inability to follow out a subject; or by general silliness of language and conduct; to complete mental disorganization, in which the patients are unable to comprehend the simplest questions, and require all their wants to be attended to like an infant. In most cases, however, even when the intellect is in this degraded state, dements can take their food themselves. When the psychical ruin is less complete, but still in cases where there is great incoherence of thought, patients are quite able to follow manual occupations, such as shoemaking or tailoring, to which they had been trained previous to their insanity. The bodily health in this state is generally good, and there may be marked obesity.

In dementia there may usually be observed traces of the particular form of derangement which prevailed at the departure from mental health. Thus, in the epileptic variety, irritability and a disposition to violence are marked features; in the general paralytic form there are the delusions of grandeur; in that of monomania fragments of the original delusions are often observable; and when it results from mania there are occasional bursts of excitement with incoherence and fragmentary delusions, making it occasionally difficult to tell whether a particular case ought to be regarded as chronic mania or dementia. The vestiges of the primary mental disorder are not, however, traceable in the last stage except in the epileptic and paralytic varieties.

Senile dementia is particularly characterized by failure of memory respecting recent events, while the long past is often remembered with considerable accuracy. There is also more or less incoherence of ideas. Sometimes there are delusions which are seldom persistent, though while they last they may incite to violence. Feebleness of purpose and facility of disposition are ordinary features. Cases are to be met with in which there are occasional attacks of maniacal excitement, lasting for a few days, and followed by depression and exhaustion. A tendency to indecency of conduct has been manifested in a number of instances. The physical signs of old age accompany this mental condition. From various causes senility may appear long before the usual period of life.

Senile dementia may occur in a different form, presenting at its commencement features resembling a common variety of monomania, that, namely, of suspicion. Groundless jealousy of near relatives and aversion to them may be the earliest marked symptoms: but there are usually also other indications of mental disturbance, such as violent explosions of anger from trifling causes, along with strange and extravagant conduct, quite at variance with the previous disposition of the individual. Ere long failing memory and other evidences of general intellectual enfeeblement reveal the advancement of the mental decay.

Although dementia is the usual form of mental derangement in advanced life, it would be a mistake to suppose that it is the only one; both monomania and mania are met with occasionally. But occurring then, these other forms often partake somewhat of dementia.

Organic dementia is the name given to a variety which occasionally follows apoplectic seizures where there is no paralysis, or which is associated with hemiplegia or other obvious organic disease of the brain. In the majority of hemiplegics, both old and young, there is marked emotional weakness, manifested by a tendency to weep immoderately to appearance, though it is seldom that any tears are shed. Occasionally in the same person there is an equal readiness to laugh, but the fit of laughter generally ends in weeping of the form described. The memory is also weak and the judgment impaired. When the paralysis is on the right side, and is accompanied by aphasia, there is, as a rule, less indication of weakened feeling than when it is on the left side. In very many cases of organic dementia the patients are stupid, silly, and facile; and on the physical side, besides paralysis, they suffer from disease of the heart or kidneys and frequently of both organs.

Acute or primary dementia is very different in its nature from the varieties which have been described. It occurs in the young, more frequently in women than in men, and is prone to affect those who are naturally feeble-minded and excitable, more particularly if there be a hereditary tendency to insanity. It is usually the result of a severe mental shock, such as fright, unexpected bad news, &c.; and its occurrence is often quite sudden, or within a few days after the shock has been sustained. The powers of the mind are in almost complete abeyance, but they are not destroyed. The patients stare vacantly when addressed, evidently not understanding what is said to them. They perhaps make grimaces or perform actions automatically, but more commonly they remain in the same position, unless moved from it, their arms hanging heavily by their sides, and their aspect blank and stupid. Their circulation is languid, the extremities and features being bluish, and their general condition is soft and flabby. Nutrition is not well maintained, and they occasionally become considerably emaciated. They are often inattentive to the calls of nature. The prognosis of this form is generally favorable, but the writer has seen several cases, especially when the cause was fright, where the disorder became permanent. He has also observed an attack of acute mania intervene between this state and recovery. Usually, however, it gradually passes away, *pari passu*, with the restoration of the general health.

It will be observed that acute dementia resembles somewhat closely "melancholy with stupor." The two forms are distinguished chiefly by the facial expression; in the latter —at least in the more common variety—it is intent and fixed, indicative of the profound mental concentration; whereas, in the former, it is vacant and meaningless. However, in cases where the element of stupor predominates over the melancholy, the diagnosis is sometimes very difficult.

IDIOCY.—Idiots, considered pathologically, have been arranged by Dr. Ireland into ten different groups; but looked at broadly and generally, in relation to their symptoms, they may be divided into two great classes—the apathetic and the agitated—between which there is every grade. Individuals of the lower types of the first class have often awkward, clumsy, and ill-proportioned bodies and coarse features; lips thick and everted; teeth irregular and decayed; gums swollen; ears ill-formed and large. Their heads are in general of good size, and are sometimes larger than the average; but they are misshapen and not unfrequently flattened in the occipital region. Mentally they are often gloomy, generally passive, but sometimes passionate and dangerous. The agitated class are quick and flighty, and run about laughing, crying, and gesticulating. They are subject to bursts of passion, and are often pugnacious. They have in general abnormally small but well-formed heads. In both classes attention and perception are exceedingly feeble; there is little memory and less judgment; and the will is imperfect—their acts being usually the results of impulses originating in their sensations. Occasionally there is an exceptional development of a particular faculty or talent, most frequently that of music. Speech is very defective, and many cannot articulate at all; squint is common; and a large proportion, especially where the condition is congenital, have what has been called the saddle-shaped palate—that is, a palate whose arch is considerably higher than the normal. A large proportion have a tendency to be of dirty habits, and occasionally the sexual appetite is very strongly developed.

Idiots, as well as imbeciles, and particularly the latter, may have attacks of melancholia, or monomania, but most frequently of mania. The acquired disorder may pass away, leaving the patient much as before the seizure, or it may continue to some extent, modifying the original condition.

Dr. Ireland holds that even in early infancy idiocy may be recognized by the slowness or awkwardness of the child's motions. He says: "If laid flat upon his face, he will sink upon the floor, whereas a normal child of a few months will try to right itself, or cry for assistance." When a little older, the wandering, unsettled eye, the inability to fix the attention, the slowness and inaptitude to learn, and the general vacancy of expression, reveal the mental defect. The state of the palatal arch, when present, is a valuable aid to diagnosis.

THE DIAGNOSIS OF INSANITY FROM DELIRIUM.—It is first of all to be noticed that in certain cases there is no real difference between insanity and delirium: thus mania, occurring in the course of pneumonia or in an advanced stage of phthisis pulmonalis, is sometimes simply delirium of an acute type. However, cases in which the two states approximate so closely are not very common, and in general the distinction is quite obvious, being marked by definite characters. (Compare p. 198.)

Delirium is very generally preceded for some days by other and more characteristic symptoms of the disease on which itself is dependent. Should that be inflammation of the lungs or brain or other leading organ; or severe injury of extremities or other parts, inducing inflammation; or one of the specific fevers, or smallpox, or other animal poison in the system; ordinary symptoms of the particular morbid state will usually have been manifest *before* the mental disturbance appears. The character of the delirium in the first instance, and also often throughout its entire course, is in most cases quiet rambling or incoherence, and these symptoms are most apt to show themselves at night, especially when the patient is drowsy, and no one is addressing him. Associated with it there are also frequently hallucinations, particularly of visions. Occasionally, however, the excitement is greater, and the patient can with difficulty be controlled. Should it spring up after injury in one of drunken habits, we have often much excitement and violence, along with fear and hallucinations. This state frequently partakes more of ephemeral mania than of ordinary delirium tremens. But though delirium is usually a late event in the disease of which it is symptomatic, occasionally, and particularly in children, it occurs early in its course; in that case, however, it is accompanied by a temperature markedly elevated, and by other acute febrile symptoms.

The physical symptoms that accompany delirium are commonly high temperature, very quick pulse, furred dry tongue, parched skin, injected conjunctivæ, scanty high-colored urine, &c.—in fact such as indicate the febrile state. These, it will be observed, do not correspond with the condition in the most common form of acute mania, where the febrile action is slight, if there be any at all. In establishing the diagnosis no symptom is so reliable as the temperature. Indeed, the determination of this point may be regarded as of so much importance that it might be laid down as a rule that in any case where the temperature is distinctly above the normal, as ascertained by the thermometer, or even by the hand, if the thermometer cannot be used, the examination should not be regarded as complete until it be ascertained if inflammatory action in one of the leading organs, or if one of the continued fevers, does not occasion the mental disturbance. In delirious mania, however, there is often elevated temperature with other febrile indications, but they are seldom so marked as in ordinary delirium. Further, in this form of mania the excitement, as a rule, is higher and more constant than in delirium, continuing without the least remission, or with snatches of sleep of not more than half an hour or an hour in duration, for days and nights together: whereas the excitement and incoherence of delirium generally vary considerably in their intensity, being often worse at night than during the day.

Much aid in the formation of the diagnosis will be obtained by the observation of the special symptoms of local disease, should these be present. It is probably most frequently in relation to the early stage of acute meningitis that doubt arises. In it there is generally injection of the eye and flushing of the face, intolerance of light and sound, considerable headache, vomiting, contracted pupils, pain and spasmodic movements in the extremities, and high temperature, and, as the disease progresses, squinting, general convulsions, dilated pupils, &c.

It will be sufficient to mention that typhus fever has been mistaken for mania: the high temperature, parched skin, ferretty eyes, and eruption, with history, should make the diagnosis clear.

From the observations that have been made, it will be understood that the diagnosis of delirium from the varieties of mania which it at all resembles, rests much more on the history of the illness and on indications of existing acute physical disease than on any very marked difference between the mental symptoms in the two conditions.

Mere drunkenness has been mistaken for insanity even by medical men. A little inquiry into the case, and the observation of the too familiar symptoms of intoxication should prevent such an error.

THE MODE OF EXAMINING A PERSON SUPPOSED TO BE INSANE is a matter of considerable importance. There is generally little difficulty where ordinary mania or melancholia are concerned, at all events when they are fully developed: it is experienced most frequently in the varieties of partial insanity. In some cases even the introduction to the supposed lunatic is no easy matter. No general rule of procedure can possibly be laid down, as this must vary according to the social status, the habits, the mental peculiarities, and many other circumstances. The frank bluntness of address that might suit a laborer would scarcely be acceptable to an educated gentleman. The writer's practice is generally —not in all cases—to drop the title of "Dr." and to be introduced as "Mr." It has seemed sometimes that the announcement of the medical title has at once aroused a feeling of suspicion and hostility, and rendered the inquiry very difficult. A few easy general observations may suffice to establish agreeable relations between the physician and the patient before the professional nature of the visit is revealed. This in the great majority of cases it would be unwise to try to conceal, as most patients would at once resent any attempt at deception. It will often, then, be advisable to quietly state to the patient that you are a physician; that you understand from his relatives that he has been somewhat out of sorts lately; that possibly it might be only supposition on their part, but it would allay their anxiety if he would kindly answer a few questions respecting his health. This being conceded, it will be well in the first instance to make some medical inquiries of an ordinary kind and then to extend the investigation to the special senses, particularly those of hearing and sight. Cautiously ask respecting noises in the ear, and if they resemble whispers or loud voices, and what they say; and in relation to the eyes, if motes or other unusual objects be seen, if they assume special forms, and if so, what they are like. Then lead the conversation on to matters relating to home and family, business prospects, religious views, &c. Of course the particular line of inquiry will frequently be guided by information previously obtained from relatives and friends, though this in some cases is incorrect and in others is defective. It occasionally happens that near relatives who are constantly beside the patient are quite unaware of the existence of dangerous delusions. In most cases the general bearing and expression of countenance indicate the nature of the morbid ideas; and, especially where the history is imperfect, this guide will save an immense amount of trouble by at once suggesting the kind of questions best fitted to draw them out. The psychological physician should be skilled in physiognomy. Many useful hints in prosecuting the investigation are also frequently obtained by the observation of peculiarities of dress, oddities about the room, and sundry other things.

But perhaps at the very commencement of the interview the patient indignantly resents the idea that he is ill at all.

Then the most judicious plan will sometimes be to sympathize with his indignation; to ask what could have made the relatives suppose that his health was impaired; and to inquire if it could be due to any plot or conspiracy, and if so, what may be the motive. This may bring out delusions of suspicion, which are common in cases where difficulty in the examination is experienced. Occasionally a lunatic who is very reticent in conversation, will express his views more freely in writing, and in this way the existence of delusions may be ascertained.

These observations illustrate the general method of procedure: they cannot do more, as the investigation in each case ought to be based on the features which are peculiar to it. It need only be further remarked that, should the patient be melancholic, the inquiry ought always, if possible, to demonstrate the presence of a disposition to suicide when it exists, as it so often does in this condition. Generally the point may be determined by indirect questions, but occasionally it is necessary to ask the patient plainly if he is weary of life and contemplates self-destruction.

FAMILY HISTORY. As insanity is a highly hereditary disease, it is important to inquire respecting its existence in the family to which the patient belongs. But the inquiry should not be restricted to mental disorder, as it is now well established that, in the descent from one generation to another, various neurotic affections—such as epilepsy, chorea, hysteria, a disposition to habitual drunkenness, particularly in its paroxysmal form, &c., are mutually interchangeable (compare p. 65). Thus it is common for an epileptic parent to beget an idiotic or imbecile child; or conversely, the offspring of an imbecile father or mother, or of one who has been insane, or is of the insane temperament, may be epileptic or idiotic. The prognosis of the mental illness would be more serious if a strong hereditary taint were present: not that the prospect of recovery from an attack of insanity, which otherwise might be curable, would thereby be much, if at all, diminished; for this is scarcely less frequent than where no such taint is in the constitution. There would, however, as an expression of the ancestral defect, be a greater tendency for the type of disease to be more grave from the beginning—showing itself, for instance, at first as a slight deviation from the normal standard, and then gradually merging into incurable insanity. As a further illustration of the constitutional vice, it is worthy of note that in patients who have recovered from one or more attacks, *recurrence* is particularly to be dreaded. The lower forms of mental disease, such as imbecility or idiocy, are peculiarly apt to be transmitted from parent to child, and a repetition of consanguineous marriages in the family is apt to become very disastrous in this way. The establishment of puberty is very trying to the mental stability of those in whom a marked hereditary tendency exists, especially to women; so also are pregnancy and childbirth. Experience shows that, as a rule, the hereditary tendency is more prone to be transmitted from father to son than from father to daughter, and from mother to daughter than from mother to son. It is to be borne in mind that the existence of insanity in the family is often denied by the relatives. The inquiry is a delicate one, and should be carried out with consideration for the feelings of those concerned.

Question of Asylum Treatment.—If the medical examiner be satisfied that his patient is insane, he will next require to consider what advice he should give to the friends —whether he should recommend immediate removal to an asylum, or a trial of treatment at home, or, at all events, elsewhere than in such an institution: the matter is one of great practical importance, and is at the same time one sometimes very difficult to determine. Many considerations besides those of a medical character must be weighed in seeking to arrive at a correct conclusion. Thus it will be obvious that if the patient be wealthy, and have kind, judicious relatives, and if his house be in a retired situation and have private ground attached, it will not be necessary to insist on so early removal to an asylum as if he be a laborer living in a small house in a crowded neighborhood; for in the former case the patient already possesses, or can readily procure, many of the advantages which an asylum presents, but which the poorer man can have nowhere else. But though these points ought to form an important element in the judgment, the main grounds will rest in the character of the disorder itself. The indications derived from it, however, can only be stated in a general way. Should the insanity, though characterized by a considerable amount of excitement, be quite sudden in its onset, without distinct premonitory symptoms, the attack often passes away quickly; a sudden seizure should then, other circumstances not being unfavorable, dispose to a trial of home treatment. More particularly, the following forms are frequently of short duration, namely, those that result from alcohol, with the exception of the paralytic dementia produced by that agent; the milder attacks of mania that are apt to occur about the establishment of puberty in both sexes, especially in the female; the so-called metastatic forms, occurring in rheumatic and gouty constitutions; the slighter seizures after childbirth and through over-lactation, though there is considerable uncertainty respecting both of them: in all these cases the medical attendant would be justified in advising that the effects of medicinal agents and other measures at home should be tested in the first instance. Patients suffering from mild types of melancholia are also frequently treated under the care of relatives; but the physician must never forget the tendency to suicide in such cases. Attacks of epileptic insanity likewise generally soon pass away, but then they not infrequently recur in connection with fresh seizures; and, indeed, the mental state, even at its best, of epileptics who have reached this stage of their disease is commonly such that the asylum is the most suitable place for them. On the other hand, insanity of slow development, which has gradually attained a considerable degree of intensity, is not likely to be of short duration; general paralysis is an unmanageable as well as an incurable form; and varieties which present suicidal or homicidal features, or both, are dangerous: all these should be consigned to an asylum at once. Further, with respect to the class in which this extreme measure may have been at first delayed, should there be no improvement, and particularly should there be rather an aggravation of the symptoms after ten days or a fortnight of treatment at home, it will then in most cases be the wisest course to recommend removal to an asylum.

CHAPTER IX.

DISORDERS OF THE RESPIRATORY AND CIRCULATORY SYSTEM.[1]

DYSPNŒA, want of breath, difficulty in breathing, pain in the chest, palpitation of the heart, cardiac spasm and anguish, a sense of impending suffocation, and all forms of labored and obstructed breathing, require so far to be considered in one group, as they frequently simulate each other, or become mixed up together. They depend on the most diverse causes. Amongst these may be named nervous or spasmodic asthma; inflammatory affections of the larynx, trachea, lungs, bronchi, pleura, and pericardium; destruction of the lung and perforation of the pleura with pneumothorax; inflammations or abscesses about the throat, larynx, or œsophagus; various forms of cardiac disease; aneurismal and other thoracic tumors; thrombosis and embolism of the pulmonary artery, dropsy of the abdomen and of the pleura and pericardium; abdominal swelling and tumors when bulky, and even some which are not very large (including the gravid uterus); spasm of the glottis as an isolated affection (laryngismus stridulus), as well as an incident in other diseases; uræmic conditions and other forms of defective renal activity; and certain varieties of anæmia, chlorosis, and hysteria.

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[1] The subjects dealt with in this chapter are usually treated of pretty fully in the various text books of medicine. They must also be considered in connection with the physical examination of the chest (see Chapter xvi. of this book, and the works referred to there). Vols. III. and IV. of Reynolds's "System," and Vols. IV., V., and VI. of Ziemssen's "Cyclopædia" may be consulted for full articles. Walshe on Diseases of the Heart and Lungs; Salter on Asthma; Hayden, Balfour, and Sansom on Diseases of the Heart; Waters on Diseases of the Chest, &c., may also be named; and likewise Gairdner's papers on Bronchitis (*Edinburgh Monthly Journal*, 1850–51), various chapters in his "Clinical Medicine," and his article on Angina Pectoris in Reynolds's "System," Vol. IV. The classical treatise of Laennec may also be consulted. Some of the subjects, such as Pertussis, Laryngismus stridulus, Croup, and Diphtheria, are dealt with very fully in works on the diseases of children. Surgical treatises, especially Holmes's "System," and Holmes's work on "The Surgical Treatment of the Diseases of Infancy," contain much that demands attention, on subjects connected with disorders of the throat, the hemorrhagic diathesis, &c. Trousseau's lectures may be referred to with great advantage on many of the matters under consideration. The description of the newer methods of examining the blood are only to be found, as yet, in the various periodicals. Dr. Wm. Roberts's lecture on *Contagium Vivum* may be referred to for a short statement on the organisms found in the blood. See also Bennett on Leucocythæmia.

DYSPNŒA, PALPITATION, THORACIC PAIN, &c.

The subject of Dyspnœa must be approached in various ways. (1) By trying to discover from the patients the character of their distress, and the causes of its aggravation, as noticed by themselves. (2) By observing the patient as regards the number of respirations, the appearance of laborious breathing, the evidence of acute suffering, or of mortal terror; by noticing any appearance of cyanoses and lividity, or of pallor in the face; and by scrutinizing the sounds, whether crowing, hoarse, gurgling, or choking, emitted during respiration. We must, likewise, notice the attitude assumed by the patient during an attack, and the character of the cough and expectoration when these are present. (See pp. 260, 268, 273.) Paroxysms of coughing from any cause may of themselves produce considerable dyspnœa, and frequently aggravate it when they are severe. (3) By an appreciation, where this is possible, of the previous facts or history of the case; particularly as to any known disease in the heart, lungs, pleura or pericardium, or anything likely to lead to perforation of the pleura (phthisis, abscess, &c.); any rheumatic attack likely to give rise to pericarditis or endocarditis; anything predisposing to thrombosis or embolism in the pulmonary artery (the puerperal state, venous thrombi, and dilated heart); any condition predisposing to rapid dropsy, especially into the pleura, pericardium, or pulmonary tissue (scarlatinal nephritis in particular); any known tendency to angina pectoris or spasmodic asthma in the individual or in his family; and any preliminary symptoms of diphtheria, croup, or laryngitis. (4) By an examination of the thoracic and other organs. By this we can often detect whether the air is prevented from entering the lungs by tumor, pressure, or spasm in the upper portions and larger divisions of the respiratory tract, or by the presence of fluid or air in the pleura, or by œdema and exudation into the bronchi, or by other forms of pulmonary or pleuritic disease. We can sometimes also detect evidences of heart disease, pericarditis, or effusion, although the distressed state of the patient is not favorable for a careful examination of the chest; dropsical accumulations or tumors in the abdomen pressing on the heart and lungs can be readily observed, and the state of the urine may throw much light on the case. An examination of the throat for an abscess of the tonsils, or for one bulging behind the pharynx, for diphtheritic patches in the fauces, or for tenderness over the larynx, is of great importance, especially in children. Laryngoscopic examination can seldom be practised in the height of an attack,[1] but on its partial subsidence we may find evidence of thickening and ulceration of the cords, or tumors, œdema, or abscess, in this situation, giving rise to mechanical obstruction or recurring spasm; or we may find paralysis of one of the cords indicating rather the origin of the attacks in some irritation of the laryngeal nerves lower down. (Many of these subjects are dealt with in other sections of this book, as will be seen on consulting the Index.)

The number of respirations per minute affords an important indication of dyspnœa. The normal rate may be stated as about 18 to 20 per minute in the male adult while awake, but variations of from 12 to 24 are not uncommon. In children, and also in women, the rate is somewhat more rapid. Like the pulse, it is much affected by different postures, and by sleep, agitation, exertion, coughing, and swallowing. The respiration is particularly apt to be deranged in its rhythm when the attention is directed to it, so that we must try to count its rate apart from the patient's knowledge. This may be done very well while taking the pulse, by continuing to hold the patient's wrist, while we watch the movements of the chest, and count them for half a minute; or, if these are not very visible, we may lay the hand or a finger very lightly and as if by accident, on the chest wall, under the clavicle in the female and below the xiphoid in the male: in other cases we can count best by listening to the breathing, or by watching the movements of the bed-clothes. In critical estimations of the rate of breathing we watch for a quiet period, or take some opportunity of noting the number while the patient is asleep, or at least before he is disturbed by speaking, moving, or crying.

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[1] Even then an examination by the finger may give some important information (see Chapter x.).

In febrile states, from whatever cause, the respiration is quickened, the increase keeping a certain proportion to that of the pulse; the ratio in health is 1 respiration to about 4 or 4.5 beats of the pulse, and so long as something like this ratio is maintained, the increase may be ascribed simply to the fever. When the rapidity of the respiration exceeds this proportion, we infer the existence of some respiratory disorder. An attack of bronchitis, for example, may be detected in this way in the course of typhus. The respiration is accelerated in nearly every variety of disease of the respiratory organs, in acute or sub-acute forms, and this constitutes one of the features of nearly every kind of dyspnœa. The number is often 40 or 50, it sometimes rises to 60 or 80 per minute, and may almost equal the pulse-rate (1 respiration to 1.25 pulse-beat).

The respiration is somewhat rapid and easily accelerated in certain non-febrile states, even apart from any special respiratory complication; the debility after fever, and certain anæmic conditions, may be mentioned amongst these. In Rickets, the rapid breathing may be due to the general state, and to the great liability of ricketty children to pulmonary collapse.

The appearance of labor in breathing is of great importance.[1] There may be very rapid breathing without any great effort or labor, but any additional strain may show at once that the breathing is maintained at the extreme limit of the patient's power; any exertion, such as sitting up in bed, and speaking, or anything which demands additional efforts, brings out the patient's weakness in this respect; he says a word or two and stops to recover breath, and then resumes. A striking illustration of the same thing is found in infantile dyspnœa; the child's whole energy is required for breathing, and so after a momentary attempt at sucking, or after one or two such attempts, he refuses the breast, although obviously anxious to drink, and probably very thirsty: this refusal is an important fact in the pneumonia and suffocative bronchitis of children. In uncomplicated pneumonia and some other diseases characterized by rapid breathing, no great effort is visible, but the state of matters is very different in cases where an obstruction exists to the entrance of air through the glottis, trachea, or bronchi,—whether this arises directly from mechanical obstruction or from nervous

[1] See also remarks under Nervous Dyspnœa, page 267.

spasm. Hence in laryngeal obstructions, and spasm from any cause, in croup, in spasmodic asthma, and in bronchitis and emphysema, the efforts at breathing often assume the most extraordinary intensity; the thoracic movements are greatly exaggerated, the muscles of the neck stand out with great distinctness, the patient sits up or even stands, and sometimes clutches at objects with his hands, so as to give the muscles greater purchase. The excessive action of the dilator narium is often a valuable index of this laborious breathing, especially in the case of children affected with pneumonia and bronchitis.

Similar results likewise happen when, instead of obstruction to the passage of the air, a large part of the breathing surface is suddenly cut off in other ways, as by the perforation of the pleura and the collapse of the lung from pneumothorax, or by sudden effusion of fluid into the pleura, or even sudden œdema, hemorrhagic condensation, or congestion of the lungs; or again, a similar result may be brought about by sudden blocking of the pulmonary artery,—although the air may enter both lungs freely, the pulmonary function is, of course, impaired by such an obstruction. This element of suddenness is of great importance in respect of dyspnœa, for if the breathing surface be cut off slowly, the respiration may have time to adapt itself to its altered condition; hence there may be extensive thrombosis of the pulmonary artery without any alarming dyspnœa, until perhaps a fatal displacement of a clot takes place; or pneumo-thorax may exist without the patient's being able to fix a probable date of its occurrence,—the collapsed lung having, perhaps, been rendered practically useless from some previous extensive disease; the whole of one side and part of the other may be full of fluid, while the patient has scarcely been conscious of breathlessness, owing to the very gradual increase of the effusion. The element of suddenness exists, of course, in all the spasmodic forms of laryngeal and bronchial obstruction. A further point of importance in connection with dyspnœa is the point at which the mechanical impediment exists; a slight œdema of the glottis may cause suffocation, and an exudation in the trachea or large bronchi gives rise to the most distressing dyspnœa from the large respiratory area thus involved.

The following are the common causes of dyspnœa, arising, directly or indirectly, in a mechanical manner: Inflammations of the larynx, œdema and spasms of the glottis, foreign bodies in the larynx or trachea; diphtheritic or croupy membranes in the larynx, trachea, or bronchi; tumors and abscesses either of the larynx itself or pressing on it or on the trachea from without (especially aneurisms, cancers, retropharyngeal abscess): aneurisms, glands or other tumors in the chest pressing on or irritating the recurrent laryngeal nerves; spasmodic or nervous asthma; inflammatory disease of the lungs, bronchi, and pleuræ; dropsical exudations into the pulmonary tissue or into the pleura; pneumo-thorax; extensive consolidation, collapse, or emphysema of the lung; extensive excavation from tubercular disease, abscess, or gangrene; embolism and thrombosis of the pulmonary artery; and pressure on the chest from below, from abdominal distension or tumors of any kind. (Compare next section.)

Cardiac dyspnœa, or cardiac asthma, as it is sometimes called, may be explained in certain cases, or to some extent, on mechanical principles. For example, a somewhat moveable thrombosis in the right side of the heart may play a similar part to that of a plug in the pulmonary artery, and incompetency of the valves or obstruction of the orifices, if extreme, may retard the circulation through the lungs, and so impair their function; or again, the lungs may be involved through the heart,—pulmonary infarctions, bronchitis, congestion or œdema of the lung, and pleuritic effusion, may all have a cardiac origin. But cardiac dyspnœa is often too extreme or too spasmodic and transitory to be readily explained on such mechanical grounds. Clinically, we must accept as a fact the frequent occurrence of the most extreme forms of cardiac dyspnœa, apart from any of the mechanical explanations or structural changes just suggested.

Orthopnœa—the assumption of the upright posture for the purpose of getting breath—is one of the great features of cardiac dyspnœa. But in cases with effusion in the pleuræ, and even in œdema or congestion of the lung and bronchitis, the patient sometimes has a considerable tendency to sit up for breath. When, however, this symptom is strongly marked, we must always suspect the cardiac origin of the illness, or the presence of some cardiac complication; and this suspicion gains in strength if there be little or no pulmonary mischief present. Thoracic aneurism is to be classed with cardiac disease in this respect. Affections of the pericardium, and adhesions of this membrane, likewise, give rise frequently to orthopnœa, although simple rheumatic pericarditis may exist without this symptom. All forms of cardiac disease—those involving the size of the heart, the tissue of the walls, the orifices, and the valvular structures—may give rise to orthopnœa. The cardiac element in the dyspnœa may, therefore, be a secondary or additional complication, appearing in the course of pulmonary emphysema, disease of the kidney, and other affections; and this complication may give rise to paroxysmal exacerbations in the midst of a chronic state of dyspnœa of moderate severity.

Occasionally the orthopnœa is so constant and so extreme that the patient cannot even lean back for a moment without the feeling of impending suffocation, and he can only get a little sleep while sitting up and leaning forward, with the head resting on his knees or hands, or on a table before him. Some patients, indeed, resolutely refuse to go to bed, and may sit in a chair for weeks and months together, without once even attempting to lie down. These extremely persistent forms of orthopnœa are usually associated with considerable dropsy.

The explanation of orthopnœa is plain enough when there is any considerable dropsy or pleuritic effusion, as the recumbent posture tends in such cases to hamper the movements of the heart and lungs from the gravitation of the fluid. Further, the erect posture no doubt gives the respiratory muscles much better purchase in their play; but the extreme difference observed in many cardiac cases cannot be reasonably explained in any such way, and appears to depend on some nervous cause.

Great increase of the dyspnœa on hurrying or climbing agrees with orthopnœa in many respects. While found to some extent in nearly every form of disease which impairs the respiratory function, it is, like orthopnœa, specially marked in cardiac affections of all kinds. A patient who is able to walk fairly enough and at a moderately good pace on a level road, may at once show signs of dyspnœa if there be a continuous although gentle ascent, or if a few steps have to be mounted briskly; hurrying and excitement operate in the same way: all of these influences often operate together in going to a high-level railway station, and patients not unfrequently first find out their weak point under such circumstances.

Amongst other causes which operate in causing dyspnœa under similar circumstances may be mentioned all forms of disease disabling the lungs, conditions of debility, anæmia,

&c., from whatever cause, disease of the kidneys, dropsy, obesity, pregnancy, and advancing age.

The importance of this feature of cardiac disease is so great, that we sometimes set our patients to run, or even to walk gently, up one or two stairs, when we are doubtful of there being any affection of the heart, so that we may judge of the state of their respiration at the end of such an experiment.

Palpitation is one of the accompaniments of the various cardiac symptoms just described, but it may also form the most prominent feature of such complaints, or it may exist quite apart from any organic affection of the heart.

When due to cardiac disease it has a tendency to very marked exacerbations in connection with exertion and excitement, so that when the palpitation occurs frequently, or chiefly, apart from these influences, and when it is not readily induced by running, or by climbing hills or stairs, we have good reason to hope that it is not due to organic disease.

The palpitation of cardiac disease is frequently associated with an undue heaving impulse, and there is usually sufficient evidence of enlargement or of valvular disease, on a physical examination of the chest. The right ventricle frequently becomes distended or displaced, so as to give rise to a painful sense of oppression and tenderness from the existence of pulsation in the epigastrium. The palpitation from aneurismal disease in the chest must be considered along with that of cardiac disease, and both investigations are conducted by similar methods; the special pulsations of aneurismal tumors must be carefully studied as to the site of their maximum intensity and diffusion. (See Chapter xvi., Part 2, the Physical Examination of the Heart.)

But, apart from these organic affections, palpitation is very common in dyspepsia, and particularly in cases with much flatulent distension of the stomach. In such cases, especially when complicated with hysterical tendencies, palpitation may attain its most extreme degrees; and in these forms it frequently proves most troublesome while the patient is lying still in bed. The palpitation of dyspepsia is often complicated with intermission or irregularity in the heart's action, which by exciting and alarming the patient is apt to increase the palpitation still further.

Palpitation is one of the leading symptoms of exophthalmic goitre: it is then associated with prominence of the eyeballs, and a certain fulness or enlargement of the thyroid gland.

Palpitation of the heart is likewise found in cases of anæmia and general debility: loss of blood from bleeding-piles and uterine discharges, for example, may give rise to symptoms liable to misinterpretation in this way. Palpitation and epigastric pulsation sometimes owe their origin to the practice of masturbation or other forms of disorder of this class.

Throbbing of the abdominal aorta is not uncommon in debilitated and nervous patients, and it may thus simulate aneurism in this situation, but a careful examination of the vessel reveals a general pulsation and fails to detect any enlargement or any true tumor of the artery. Throbbing of the arteries in the body generally may likewise be felt by patients; this may arise from a relaxed state of their vessels, apart from any very serious affection, although such generalized pulsation likewise occurs in cases of aortic valvular disease.

Pain in the Chest exists in a great many cases of dyspnœa, and sometimes constitutes the leading feature and cause of the respiratory distress; this is especially marked in cases of pleurisy and pericarditis during the stage of friction; the movements of the chest are actually hampered by the pain induced by them. Similar distress is sometimes occasioned by pleurodynia. The detection of friction sounds over the heart and lungs in such cases explains their nature. The pain or distress in dyspnœa may, on the other hand, arise simply from the extremely urgent need for breath which the patient experiences; when carried beyond a certain point, this becomes exquisitely painful. It is intensified by any coincident palpitation or tumultuous action of the heart, by certain irregularities or imperfections in its contraction, which are often quite discernible by the patient, and these may depend not merely on affections of the organ itself, but on pressure on it or displacement of it in connection with pleuritic exudations, pneumo-thorax, thoracic and abdominal tumors, excessive dropsy, or even by distension of the stomach and bowels in cases of flatulence. Many cases, of course, have a complex origin, as when the pain of a perforation in the pleura and the incipient pleuritis thus induced are complicated with the extremely urgent dyspnœa resulting from the sudden suppression of a lung, and from the pressure on the heart due to displacement of the mediastinum. The combination of cardiac, pericardial, or aneurismal pains with pleuritic stitch; and the association of these with the most extreme forms of dyspnœa resulting therefrom, or from œdema or consolidation of the lung, and dropsy, give rise to a complex distress which we have too often to witness.

A certain simulation of these alarming states sometimes arises in connection with flatulence, as this may be associated with pain in the neighborhood of the heart, with great palpitation, and, especially, in hysterical cases, with dyspnœa and a sense of choking. Gouty, neuralgic, and intercostal pains, and various sensations referable to uterine irritation, may also occasionally simulate the attacks just mentioned, or even those included in the next paragraph.

Angina Pectoris is a name reserved for pain obviously of cardiac origin and of a very special and alarming character; all forms of cardiac anguish, although not presenting the features of this complaint in its most typical form, have a certain resemblance to this peculiar suffering. "The subjects of angina pectoris report that it is a suffering as sharp as anything that can be conceived in the nature of pain, and that it includes, moreover, something which is beyond the nature of pain, a sense of dying." (Latham.) Others speak of a feeling of constriction of the thorax, of its being an "inward" pain, or of its resemblance in some way to suffocation. But the most typical angina may occur without the least impediment to the respiration, and the patient may feel that he can breathe quite freely. The pain is not always centred in the cardiac region, but it always tends to the left side of the chest. The most constant of all the features of true angina is an indescribable dread of immediate death, or perhaps, as has been said, "a *sense* of dissolution, not a fear of it." In the case of those who cannot express their feelings accurately, or who do not care to do so openly, we can sometimes detect in their countenances the evidence of a mortal terror. Along with the above there is often a transient pallor of the face, and likewise an associated pain shooting down the left arm, or darting across, as it were, from the heart to the elbow, or there may be numbness and tingling of the arm, spreading even to certain fingers.

The most typical forms of angina pectoris may exist without any lesion recognizable during life, and the dissections often show merely certain changes in the structure of the walls, especially fatty degeneration of the fibres and atheroma of the coronary arteries; but nearly every form of cardiac lesion may be found in cases of angina; and in like manner we may say that indications of angina-like attacks may frequently be traced as forming an element in the complicated sufferings of heart disease.

The character of the noise heard during the breathless attack often guides us. The presence of snoring, or of very rough and loud-sounding respiration, is found in cases of tracheal obstruction (croup, diphtheria),—the variation in the sound often suggesting a gradually diminishing aperture for the passage of the air. Something of the same kind of breathing may be heard where abscess behind the pharynx, or even in the tonsils, causes much dyspnœa. When the obstruction consists in a spasmodic closure of the glottis, the sound is more crowing or stridulous (pertussis, laryngismus stridulus, irritation from foreign bodies, ulceration or tumor in the larynx, or pressure on the laryngeal nerves, &c.). If the constriction be further down, whether spasmodic or mechanical, the breathing may have more of a wheezing or whistling sound. If much fluid scretion exist in the trachea and larger bronchi, gurgling sounds may be loudly heard. But some of the most severe forms of dyspnœa and gasping respiration may exist without noisy respiration, as in embolism of the pulmonary artery, and rapid effusion into the pleura or pericardium. In cardiac and aneurismal dyspnœa, the presence of noisy respiration will depend on the nature of the pulmonary or laryngeal complications.

Lividity or duskiness of the face (Cyanosis) is a feature in dyspnœa requiring careful attention; in extreme forms a similar condition can sometimes be recognized also in the fingers and other parts. All diseases or accidents interfering with the entrance of air to the lungs, or with the efficiency of the respiratory function, may produce cyanosis. A tinge of lividity can often be detected along with the febrile flush of pneumonia, of phthisis, and of acute tuberculosis, especially if these diseases be extensive. A certain degree of it is habitual in all serious forms of acute bronchitis; in this latter complaint, in children, the blue color of the face is an indication of considerable gravity. In attacks of bronchitis supervening on extensive emphysema, lividity is habitual, and often excessive. In extreme pleuritic effusion, likewise, lividity indicates the gravity of the condition. In extensive excavation or destruction of the lung, and also in pneumothorax, lividity is often very marked. In cardiac disease of nearly every form lividity is apt to appear, giving, perhaps, a dusky flush on the cheeks; this may be so habitual as to lead to changes in the tissues (induration and even inflammation). If the cardiac disease involves the tricuspid valve, more extreme lividity may take place. In malformations of the heart, and defects permitting the communication of blood from the right to the left side directly, extreme lividity usually exists; in infancy this may often be seen to come on during crying, or at certain times only, owing, no doubt, to the varying efficiency with which the fœtal orifices are closed. The term "Morbus Cæruleus" is applied to this condition. The most extreme cyanosis, however, may exist from such congenital causes without the least dyspnœa. Amongst other causes of lividity, not especially referred to in the above, may be mentioned cholera during the stage of collapse, and the cases of inhalation of gases which are not adapted for respiration (nitrous oxide, chloroform vapor, carbonic acid, &c.).

Altered Rhythm of the Breathing; Nervous and Renal Dyspnœa.—Alterations in the rhythm of the respiration sometimes occur. In health, the breathing, although regular and rhythmical on the whole, frequently presents an occasional inspiration of greater depth than usual, a fact of which we have frequently to avail ourselves in the auscultation of young children. But very marked alterations in the respiratory rhythm are found in certain cases of cardiac disease (especially dilated and fatty heart), and sometimes in cerebral affections, or even in certain fevers where cerebral symptoms supervene. The breathing referred to is sometimes named "suspirious" or "sighing," and in slight forms may consist of a few quick gasps, or deep sighing inspirations, followed by a period of slow and shallow respiration, or by a very temporary suspension of the process. This form of breathing may be associated with attacks of "angina sine dolore" (Gairdner), as manifested by the look of anguish and general distress depicted on the countenance of cardiac patients, without, it may be, any very definite pain. This suspirious respiration is often present, likewise, in very variable degree, in some cases of cerebral disease, and also in the course of fevers where cerebral symptoms have arisen. In its most marked character it is spoken of as the *Cheyne-Stokes Respiration.* "It consists in the occurrence of a series of inspirations increasing to a maximum, and then declining in force and length until a state of apparent apnœa is established. In this condition the patient may remain for such a length of time as to make his attendants believe that he is dead, when a low inspiration, followed by one more decided, marks the commencement of a new ascending and then descending series of inspirations" (Stokes). This extreme form is chiefly characteristic of fatty degeneration of the heart's fibres. Some profess to distinguish between the "Cheyne-Stokes Respiration" and the sighing or cerebral respiration just referred to, but the difference seems to be one of degree rather than of absolute quality. In any case they present sufficient resemblance to be classed together in this section.

Labored respiration constitutes a common feature in cerebral apoplexy, dating sometimes from the very beginning of the attack, in the severe forms with deep unconsciousness; appearing in the course of a day or two in the cases which begin in a less alarming way although advancing towards death. This disturbance of the respiration is probably due in part to the direct affection of the pneumogastric and other nerves, but in the later developed cases the lungs also no doubt become involved to some extent from the unconscious and paralyzed condition of the patient. In the unconscious period after convulsion fits the same state of the breathing may be present.

Nervous dyspnœa, however, may occur in a marked form apart from any serious nervous lesion, and quite apart from any evidence of the respiratory or circulatory organs being diseased. Such attacks are found chiefly, if not exclusively, in women, and are usually complicated with hysteria. Allied to this is the dyspnœa sometimes found in the earlier months of pregnancy, where no sufficient explanation can be afforded by the abdominal distension; indeed it may pass off as the abdomen becomes larger.

Renal dyspnœa may show itself as an early symptom of the disease, appearing very readily on exertion; but a more extreme form of breathlessness, resembling an asthmatic attack, appears sometimes in affections of the kidney apart from œdema, cardiac complications, or the other influences already discussed.

Before any negative conclusion can be arrived at warranting the diagnosis of nervous or renal dyspnœa, and before any diagnosis of one form of dyspnœa to the exclusion of others can be safely made, the most careful exploration of the respiratory and circulatory organs must be undertaken, and the features of the whole case must be viewed from various aspects and even perhaps watched for some time in its various phases (see Introductory Remarks, p. 256).

COUGH.

Cough is a leading symptom in many diseases; it sometimes constitutes the chief complaint of the patient, but in other cases we have to inquire very particularly as to its presence. In all cases of dyspnœa and thoracic disease the indications afforded by its absence, or by its special characteristics when it is present, must be regarded as most important. Occasionally it is so slight, and the patient has become so much accustomed to it, that it is only when attention is specially directed to it that its existence is noticed; in such cases those who live with the patient can often give us more reliable information than the patient himself. Such slight forms of cough, occurring chiefly in the morning, may constitute one of the early symptoms of phthisis. Although a very constant indication of pulmonary affections, cough is occasionally absent even in serious and advanced disease of the lungs, so that the mere absence of this symptom is no security for the soundness of these organs. Moreover, extensive pleuritic effusions frequently become developed without any warning from this symptom.

In the investigation of cough we inquire whether it seems dry or moist, and what kind of expectoration, if any, is brought up; if the cough is loud and clanging, or with a barking or brassy sound, associated with hoarseness, or with imperfection in the closure of the glottis; if there is a sense of constant irritation with the cough, or if the act of coughing seems to clear away some obstruction; if it comes in paroxysms, or if it is more persistent and regular in its occurrence; if it comes on at particular times, as on going to bed at night or getting up in the morning, or on passing into a colder atmosphere, or on speaking; if it is set up by any special posture, as by lying on the back, or on the one side as compared with the other; if it is habitual in winter, disappearing or getting much less in summer time; if it is associated with retching, or terminated by an act of vomiting; and if there is stridulous or crowing inspiration associated with it. The duration of the cough, the site and character of the pain, if any, the presence of dyspnœa, the special character of the sputum, and the examination of the chest, constitute important points in the further inquiry.

The presence of cough always suggests the existence of some kind of disease in the respiratory tract, but we know that a cough may be induced in a reflex manner. Thus aneurismal or glandular tumors in the mediastinum may produce spasmodic or paroxysmal attacks of coughing; syringing the ears has been known to produce coughing, and probably certain forms of disease in this situation may likewise do so; in hysterical attacks, and in pregnancy, cough may be set up apart from any disease of the air passages; and certain forms of gastric irritation may likewise produce a reflex cough. But "stomach coughs" and the other forms of reflex cough are not to be too readily accepted; the most careful examination of the chest must first be made in all such cases.

In *Pertussis* (whooping-cough) the violent cough is the chief fact; there is usually, however, more or less bronchial catarrh also, the signs of which can generally be found in the lungs, especially if we listen just before a paroxysm of coughing. This disease is rare above the age of puberty; it is infectious, and one attack usually protects the patient from subsequent ones, but a relapse after an interval of freedom for some weeks or months is not uncommon. These points are often important in the diagnosis. In the early stage the cough is characterized by a rapid succession of expiratory acts, without much pause between them, so that the child's face rapidly becomes red; this peculiar cough comes in paroxysms, and may often be recognized as whooping-cough by an experienced ear even before the "whoop" becomes developed. This "whoop" is a long-drawn crowing sound, coincident with the inspiratory act which follows the violent series of coughs; this peculiar sound is due to the passage of the air through a glottis partially closed by spasm. This sound may be loud and resounding, or it may be somewhat choked or inaudible or quite suppressed, through excess of the spasm. The child's face, by its blueness, indicates the gravity of these fits ("dumb kinks"). To the violent paroxysmal acts of coughing the name "kinks" is applied by some mothers, the term "whooping" being reserved for those attacks associated with "crowing." Certain cases pass through their course without a single paroxysm of "crowing" being heard, but this is quite exceptional. The paroxysm of whooping-cough is often terminated by vomiting, the contents of the stomach coming away freely, and in many cases there is much glairy and sticky phlegm also. The cough sometimes produces bleeding from the nose, ears, and eyes; great suffusion and much swelling of the eyes and face are common. All degrees of feverishness and prostration are found in whooping-cough, but these are usually present to a serious extent only in those cases associated with much catarrh, with diarrhœa, or other complications. In the intervals of the paroxysms the child seems often perfectly well. In the diagnosis, the presence of an ulcer on the frenum linguæ is sometimes of considerable value; it appears in about one half of the cases soon after the paroxysmal cough has been fully developed. It only occurs in those who have incisor teeth in the lower jaw, so that it seems to have a purely mechanical origin. This ulcer disappears with the diminution of the cough. The paroxysmal cough of pertussis, and also the ulcer, may both disappear with the advent of serious complications (pneumonia, convulsions, &c.) and may reappear after these have passed away.

A crowing inspiration, somewhat resembling that of pertussis, is found in young children in the disease known as *Laryngismus stridulus:* it is due, as in whooping-cough, to spasm of the glottis, but there is not usually any special cough in Laryngismus. This disease affects rickety children in particular, and is frequently associated with attacks of general convulsions.

Another disease associated with paroxysmal cough and crowing is that known as *Bronchial phthisis*, due to tubercular affections of the bronchial glands. This often bears a close resemblance to pertussis. The history of a former attack of whooping-cough, or the absence of any evidence of infection received or transmitted, and the chronicity of the complaint frequently assist in the discrimination of this disease.

In *Measles and Influenza* the disease, although of a general nature, falls specially on the organs of respiration, and manifests itself by cough among other symptoms. A certain degree of pulmonary catarrh with more or less cough is present in many other febrile diseases.

Irritation of the throat or glottis may set up a cough in a mechanical way. Thus the passage of fluids or solids towards the larynx may produce violent coughing, which tends to persist for some time after the irritation is removed. Greedy sucking on the part of a thirsty infant, the trickling down of fluids from the posterior nares (post-nasal catarrh, &c.), and the presence of an elongated uvula may be mentioned under this heading. Certain irritating gases, such as chlorine and sulphurous acid, likewise produce violent paroxysms of coughing in healthy persons; and in those rendered specially susceptible from disease in the larynx or bronchi, the passage from a hot to a cold atmosphere, or the reverse, may set up violent fits of coughing.

A Laryngeal cough is often loud, clanging, and very frequent and irritating; it may also be hoarse and imperfect (see p. 300). Ulceration and thickening of the mucous membrane may give rise to both forms; the ulceration is often associated with tubercular or syphilitic disease. Tumors, œdema, abscesses, &c., operate in the same way. Direct pressure on the trachea by an aneurismal or malignant tumor may give rise to a croupy quality of the cough, usually associated with stridulous respiration. In paralytic affections of the larynx the cough, like the voice, is usually hoarse. All forms of laryngeal irritation are apt to give rise to spasms of the glottis. This imparts a stridulous character to the inspiratory acts associated with the cough. In laryngeal ulceration streaks of blood are common in the sputum, but the expectoration is seldom profuse. An examination of the larynx by the laryngoscope (see Chapter x.), and of the chest, for any signs of tubercular disease, aneurism, or thoracic tumor, and an inquiry as to the presence of constitutional syphilis, are all very important points in such cases. A barking, brassy cough is common in croup, and also in diphtheria, when it attacks the larynx and trachea. Along with this quality of the cough we have noisy breathing, which can usually be recognized at once as due to obstruction in the upper part of the air passages. An examination of the fauces may reveal the white patches of diphtheritic exudation, the extension of which to the larynx has caused the obstruction. When the disease begins in the trachea there is usually a period of illness for a day or two days, associated with high fever, prior to the appearance of any alarming obstruction to the breathing. Very sudden attacks of hoarse, croupy cough, coming on in the night, and subsiding quickly on the use of warm baths, emetics, etc., are usually due to a form of laryngitis. (To this, and also to Laryngismus stridulus, the name "False croup" is sometimes applied.) Croup and laryngeal diphtheria cannot be separated clinically; an attack of apparently typical croup may occur amidst, or seem to give rise to undoubted diphtheria. Occasionally shreds of membrane are expectorated or coughed up in these affections.

Foreign bodies of the most diverse kinds sometimes pass into the trachea or into one of the bronchi; in the act of entering violent and paroxysmal cough is set up, but as this may gradually subside much doubt may remain as to whether the foreign body was swallowed, or whether it actually passed down into the trachea. In the latter case, the cough usually continues to recur in paroxysms of varying intensity, and severe or fatal spasm of the glottis may supervene. In cases of this kind, assuming a chronic form, the cough may simulate that of advancing phthisis; and emaciation, sweating, and feverishness may all add to the resemblance; subsequent dilatation of the bronchi, the formation of cavity, and the secretion of pus may add further to the difficulties. Indeed, the discrimination may be impossible; but when the history clearly points to the accident in swallowing as the date of the appearance of the cough, when the family history is good, and the physical signs of phthisis equivocal in any way, the possibility of this form of disease, and the question of surgical exploration or interference must be entertained.

In all varieties of bronchial and pulmonary disease cough is almost always present, sometimes in slight forms, sometimes in suffocative paroxysms of great severity. In the pneumonia of children, however, it is seldom present in the early stage. In pericarditis also cough is often a troublesome symptom; it has sometimes a hoarse quality. In pleurisy, apart from complications, there is sometimes an absence of cough; but pleurisy frequently accompanies pneumonia and phthisis, and when cough is then present, it is often extremely painful—the pain being referred to the site of the pleuritic inflammation. Similarly pain with the cough occurs notably in pericarditis and peritonitis, and also in rheumatic affections of the muscles. In bronchitis the pain associated with the cough is usually substernal. The character of the expectoration, the physical examination of the chest, and the previous history must be relied on in seeking to ascertain the cause of cough in pulmonary disease. It must be remembered that cardiac, aneurismal, or renal affections may constitute the primary disease of which the pulmonary mischief is but a manifestation or complication.

EXPECTORATION.

The expectoration of hospital patients is usually preserved for inspection as a matter of routine. Earthenware spittoons are generally employed, but glass dishes have the advantage of showing the character of the expectoration somewhat better, especially if it is abundant. In private practice we have to direct the patient to preserve the sputa, when this is a matter of importance, as in pneumonia and cases of hæmoptysis. Little vessels, soap dishes, or articles of a similar size, are generally at hand in the bed room, and can be used for this purpose. When the quantity is large we have sometimes to pour the contents slowly from one vessel to another, so as to judge of their character and admixture; or by emptying them on to a blackened plate we may be able to pick out little pieces for more critical examination. While thus emptying the contents we are able to notice any fetor, or the peculiar odor of gangrene, if these be present.

We describe the expectoration as to its quantity in the twenty-four hours; as to its composition, whether mucous, purulent, muco-purulent, or bloody; as to its consistence, whether thick or thin, composed of separate and defined sputa, or more homogeneous; whether tenacious, viscid, fluid, or frothy. The frothiness may show itself as large air bubbles, or these may be so minute and so much mixed with the mucus as to require close examination. Various impurities are often mixed up with the expectoration,—as matters from the stomach, pieces of food from the mouth, and accidental particles carried in from the air. Coloring matters suggestive of blood may be derived from the brown crust of bread, from wine, from tobacco juice, and the coloring of sweet-meats.

In health a little mucus is expectorated, and in disease the sputum may consist chiefly of mucus. In smoky towns this is very apt to be of a dark color from the presence of floating soot; and in the case of miners, from similar causes, the expectoration is usually black. Occasionally, however, the black color is derived from the pulmonary pigment in cases with breaking up of the lungs.

Frothy mucus, sometimes rather watery, is often expectorated in acute bronchitis and œdema of the lung. Minute aeration of the sputa is often found in the tenacious mucus expectorated in pneumonia, but this is usually rusty or distinctly bloody. (See p. 275.)

Purulent sputa cannot be absolutely separated from mucous sputa, as the two conditions merge into each other, and an intermediate condition is often named "muco-purulent." These forms of expectoration must also be described as to their frothiness, consistence, color, &c. The sputa may consist of almost pure pus; and when these spread out so as to form flat masses resembling the shape of pieces of money, they are called "nummular"; when they retain a spherical form they are termed "globular." Both of these forms are commonly seen in cases of advanced phthisis, but nummular sputa may often be found in chronic bronchitis also. Purulent expectoration is common in all chronic forms of catarrh affecting the respiratory tract. Very profuse expectoration of pus (Bronchorrhœa), usually of a fetid character, may proceed from dilated bronchi. A sudden profuse expectoration of pus, or the sudden increase of it, may depend on the bursting of a tubercular vomica or of an intrapulmonary abscess, or it may be due to the opening of a collection of pus in the pleura into a bronchus, or to the opening of a hepatic abscess through the diaphragm; or, more rarely, to the bursting of some abscess in the mediastinum or elsewhere. When an empyema bursts in this way the pus expectorated is usually rather fluid, and it may come up in large quantities. The signs of hydro-pneumo-thorax usually become developed after such an accident, but this is not always the case. The pus from a pulmonary abscess may or may not be fetid; possibly it may have a gangrenous odor; its quantity on any one day is usually moderate (say 12–18 oz.), and the microscope may reveal shreds of lung tissue in great abundance, and in some cases blood crystals are also present. Such abscesses are sometimes due to embolism of the pulmonary artery. Hepatic abscess usually declares its presence by symptoms and facts pointing to the liver before it gets the length of perforating the lung.

Fibrinous shreds from the trachea are sometimes expectorated in croup and diphtheria, and fibrinous casts of the smaller bronchi may occur in connection with Plastic or Fibrinous Bronchitis.

Little *cheesy masses* sometimes come from pits in the tonsils; but these, and also *calcareous masses*, may be expectorated in cases of old standing phthisis. *Shreds of hydatids* may be brought up in connection with hydatid cysts of the lung and also of the liver. (See Fig. 42.)

The expectoration of blood (Hæmoptysis) is always a most important fact. Care must be taken to avoid errors from the presence of coloring matter accidentally mixed with the sputum; the microscope may here be called in to discriminate the red blood corpuscles. The Guaiac test used for urine is not here available. But even when we are sure of the presence of blood, this may possibly come from spongy gums, as many persons' gums bleed very readily, and especially if they are sucked; or the blood may come from the nose, trickling down the posterior nares, even when none appears from the nostrils; or the blood may come from ulcerations, &c., in the throat or in the larynx. The mention of the sources may serve to direct our attention in scrutinizing the source of the bleeding. Or, again, especially in profuse bleeding, there may be a question as to whether it comes from the stomach (Hæmatemesis, see p. 312). Blood from the lungs is usually more florid and more frothy than that brought up from the stomach: the latter is usually dark and acid, and may be mixed up with partially digested food. The term "vomiting" of blood, as used popularly, signifies the bringing up of any large quantity of blood, whether from the lungs or stomach. Even when it comes from the lungs, the action resembles very much that of vomiting. Difficulties in the diagnosis may arise from blood from the lungs being in part swallowed before it is vomited up again.

When the blood really comes from the lungs, whether it be in large or small quantity, it is always a serious fact. The least grave form, perhaps, is the presence of slight streaks in the expectoration in connection with violent fits of coughing, or during an attack of moderately acute bronchitis.

The rusty sputa found in pneumonia owe their color to blood; in some cases the presence of blood is very pronounced in this disease. The rusty color is produced by the very intimate admixture of blood with the mucus, and this secretion is usually very tenacious, as can be shown by turning the vessel upside down: minute air-bubbles may often be seen in this expectoration. This rusty expectoration is very important in the diagnosis of pneumonia from pleurisy and other affections, although it is occasionally absent—notably in the case of children, and also usually in the pneumonic consolidations of typhus.

Closely allied to the rusty spit of pneumonia, although often more distinctly bloody and more largely aerated, is that of valvular heart disease, or that which is found in minute aneurismal hemorrhages into the trachea, or that of pulmonary infarctions due to embolism of the pulmonary artery. This last form arises in cases of heart disease, and also in diseases characterized by a tendency to venous thrombosis (child-birth, &c.). The coexistence of pleuritic friction with evidence of pulmonary consolidation and hæmoptysis has sometimes been noticed in cases of this kind.

Another form of intimate admixture of blood assumes a darker color, somewhat resembling prune juice: this occurs in cases where the blood lingers longer in the pulmonary tissues; it is found in cases of chronic pneumonia going on to destruction of the lung, and also in certain cases of aneurismal hemorrhage, where the openings are so minute as to leak only to a slight extent.

A form of bloody spit, somewhat resembling the appearance of red currant jelly, is sometimes seen, and is regarded as characteristic of pulmonary cancer.

Hemorrhage from the lungs may occur as part of a general hemorrhagic tendency, as in purpura and hemorrhagic small-pox: the exact appearance of the blood will vary according to the extent and situation of the special bleeding. In certain cases of irregular or suppressed menstruation the discharge is said to find its escape occasionally from the lungs. This idea of "vicarious menstruation," however, must always be regarded with the gravest suspicion, especially in young subjects, as suppressed menstruation and hæmoptysis afford strong grounds for suspecting pulmonary phthisis; this doubt can only be set aside by careful watching over a lengthened period. Large hemorrhages from the lungs occur in phthisis both in its earliest and its latest stages, in cardiac affections, especially in diseases of the mitral orifice and valve, and in cases of thoracic aneurism bursting into the trachea or bronchi. With regard to phthisis the profuse hemorrhage in the early stage is not very intelligible; it may occur while as yet there are no physical signs of consolidation, and not very unfrequently there is even an absence of the physical signs we would expect from the presence of blood in the air vesicles: usually, however, some moist râles can be heard. (A slight hæmoptysis frequently repeated is much commoner, of course, in phthisis than these alarming attacks.) Large hemorrhages in the late stages of phthisis are usually due to the giving way of some considerable artery, destroyed probably in the course of the ulcerative process. Sometimes these hemorrhages are due to the rupture of an aneurism of the pulmonary artery. These aneurisms form in old phthisical cavities, and frequently give rise to smart hemorrhages, or to constant staining of the sputa for some time before the fatal hæmoptysis occurs.

Hæmoptysis from heart disease may be inferred, as a rule, when valvular disease of the heart is discovered, apart from any signs of aortic aneurism. The large hemorrhages from rupture of aortic aneurism are usually almost immediately fatal, but the patient may rally for a time. Such hemorrhage is generally preceded by slighter forms of bleeding, but sometimes a profuse hæmoptysis is the first indication of aneurismal disease.

Microscopic examination of the sputum is useful in determining the presence of pus and blood corpuscles, the presence of booklets, &c. from hydatids (Fig. 42), and the occurrence of crystalline forms, such as cholesterine and blood-crystals. Scales of cholesterine (Fig. 43) are found in the sputa, in some of the cases in which a pleuritic exudation has opened into the lung: they may just possibly occur also in cases of long-retained secretions within the lung itself. Brilliantly colored blood-crystals in the sputa are found, at times, in connection with hemorrhagic infarctions which have gone on to abscess. Various forms of vegetable growths are often found on microscopic examination, but these are not usually of much importance. Fragments of pulmonary tissue are sometimes so abundant, especially in cases of pulmonary abscess, that they can be found on placing a drop of the purulent expectoration on a microscopic slide, without preparation of any kind. In cases of phthisis, however, the fragments are not so numerous, or are too much entangled in thick pus to be found in this way.

Sometimes by picking out with needles little fragments from the sputa, we may hit upon pulmonary tissue. Another method, recommended by Dr. Fenwick, consists in liquefying the pus by means of caustic soda. A solution containing about twenty grains to the ounce is added in equal volume to the expectorated matter brought up during a night; this is cautiously boiled in a flask or flat dish, so as to allow of efficient stirring and mixing: the mixture is just boiled, and if still not sufficiently liquefied a little more of the solution should be added. Prolonged boiling and too much alkali tend to dissolve the fibrous tissue searched for, and so must be avoided. The liquefied mixture is placed in a cylindrical glass vessel, and after it settles, a few drops of the sediment may be examined with the microscope, or a portion of the liquefied material may be placed in a similar vessel, and three or four volumes of water added to it so as to assist the precipitation of the pulmonary fragments.

In examining the sediment a few drops should be lifted by means of a dipping rod (not drawn to a point), and these should be placed on a large slide or shallow cell; the layer of fluid must however be very thin. A low power should be used—an inch or half-inch objective—and if any group of fibres resembling the arrangement of the pulmonary cells can be seen, higher powers may be used to resolve their structure. Occasionally separate yellow elastic fibres can also be recognized with their typical curling at the ends. The pieces vary much in size: sometimes only a few loose fibres can be found. (See Fig. 29.)

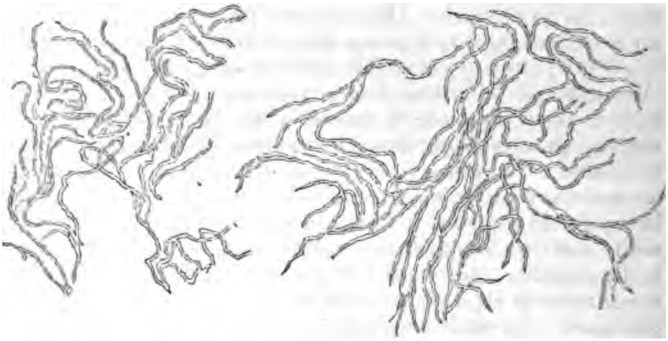

Fig. 29.—Lung tissue obtained from sputa after digestion in caustic soda. (Drawn by Dr. John Wilson.)

Several things tend to confuse the beginner in this inquiry. Portions of vegetable tissue, from the food or from accidental admixture, are often found, as they resist of course the caustic action of the soda; their cellular structure sometimes misleads. More misleading still is the appearance of certain vegetable growths; but their branching and interlacing fibres usually guard us from error. A good plan for the beginner is to secure some pus from a phthisical cavity, at a post-mortem inspection, and by subjecting this to microscopic examination after digestion in soda, and also without any such preparation, he becomes familiar with the appearances searched for, apart from most of the structures which tend to confuse. Fragments of pulmonary tissue are found in cases of phthisis and in cases of pulmonary abscess: their presence assists sometimes in distinguishing pus vomited from an abscess from that of an empyema opening into the lung.

HEMORRHAGES.

In the investigation of a case of anæmia, and in conducting certain parts of other inquiries, we have sometimes to ask about the occurrence of any serious loss of blood. Such losses may be serious from their great severity, or from their long continuance. It is often necessary to enumerate to the patient the various forms of hemorrhage, as otherwise we may fail in ascertaining the facts. Thus we inquire for any excessive bleeding occurring from the surface, from wounds, ulcers, leech bites, &c. In the case of women, we ask about any losses of blood in connection with abortions, or with childbirth; and for any other hemorrhages from the womb (Menorrhagia, Metrorrhagia). Spitting or vomiting of blood, whether from the lungs or stomach (Hæmoptysis and Hæmatemesis) and bleeding from the nose (Epistaxis), or from the gums, can scarcely be overlooked. Passing blood from the bowels, and the bleeding from piles, should be inquired for *separately*, and the change of color in the blood, giving rise to dark or tarry motions (Melæna), should be explained to the patient. Blood in the urine (Hæmaturia) is usually recognized as such by the patient if very profuse and long continued, but smaller quantities may escape notice; subcutaneous hemorrhages or blotches, and purple spots may also be inquired for.

Most of these forms of bleeding are discussed under their special sections, but bleeding from the nose (Epistaxis) requires some special notice here. Like other forms of bleeding, it may be due to general causes, such as purpura, &c. (see p. 280), this form of hemorrhage being but one of the manifestations.

Epistaxis also occurs in connection with severe headache, arising either from functional disturbance, or from cerebral disease. The hemorrhage is followed sometimes by considerable relief; it may be brought on in some persons very readily by excitement and heated rooms. It is not uncommon in the early stage of enteric fever, and it also forms an early symptom in certain cases of cardiac and hepatic disease of various kinds. It occurs sometimes also in renal affections. Epistaxis and other forms of hemorrhage are not uncommon in connection with disease of the spleen. Bleeding at the nose often arises in direct connection with the violent paroxysms of whooping-cough, and it may be associated in this disease with bleeding from the eyes and ears. Sometimes, although rarely, this bleeding from the nose is so readily excited by the fits of coughing, and is so excessive, that we must suppose some peculiarity in the system at the time, especially as this proclivity, after lasting for a while, may pass away, although the fits of coughing continue, or even become more violent. Bleeding from the nose may be from one nostril only or from both. In many cases the blood goes back to the throat; and it may be swallowed or brought up according to the strength or the position of the patient. Slight bleeding from the nose is often due to picking the nostril. This occurs in children chiefly, and is suggestive of gastro-intestinal irritation from worms, diarrhœa, &c.

Amongst the general causes of hemorrhage, applying to many or most of the forms, may be mentioned purpura hemorrhagica and hemorrhagic smallpox. Bleeding at the nose often arises in enteric fever, probably from general causes. Intestinal hemorrhage is mostly due to the local affection in this disease. In relapsing fever, menorrhagia and post-partum hemorrhage are common; and floodings after abortions or parturition are sometimes most alarming in typhus fever and smallpox.

Scurvy resembles purpura in predisposing strongly to hemorrhage from the gums and elsewhere, and also from the ulcers which arise in its course. The hemorrhagic diathesis (Hemophilia) must also be mentioned here. The bleedings connected with this state may be spontaneous—apart from any obvious injury, but more commonly they arise from slight wounds or pricks; leech bites are peculiarly apt to be intractable. Affections of the joints sometimes appear in young subjects in connection with this state, or during an interval of its suspension. The hemorrhages from chronic hepatic, cardiac, and renal disease are usually determined by local conditions—cardiac disease giving rise especially to hæmoptysis, hepatic disease to gastric, intestinal, or hæmorrhoidal bleeding, and renal disease to hæmaturia—but a general influence can also be traced in all, from their tendency to be associated with small subcutaneous hemorrhages and epistaxis. Hemorrhage under the conjunctiva occurs at times in renal disease, and retinal hemorrhage is a well-known complication. Cerebral hemorrhage is likewise common in renal disease, especially when associated with cardiac hypertrophy.

In the forms of splenic enlargement due to malarial fevers and other causes, and in the different varieties of leukæmia and lymphatic disease, epistaxis and subcutaneous hemorrhages are common.

EXAMINATION OF THE BLOOD.

Apart from the superficial examination of the blood lost in hemorrhages of various kinds, much may be hoped from an elaborate chemical and microscopic investigation of samples of the blood in different forms of disease. Hitherto comparatively little has been made of this form of inquiry, but indications of its growing importance are not wanting. With regard to the chemical department of this subject there are two great difficulties. We have to face all the complications of one of the most difficult departments of organic analysis, while but few physicians in actual practice, if, indeed, there be any, are adequately prepared for such investigations. The works of Hoppe-Seyler may be referred to for the best instructions in this branch of chemistry. But, further, we are confronted with the practical difficulty of obtaining samples of blood at such times and in such quantities as chemical analysis demands: the cessation of venesection as a common form of treatment renders this scarcely possible. While this practice was common, attention was much directed to the presence or absence of the "buffy coat" in the blood removed by bleeding, an appearance so usual in the blood drawn from the veins in inflammatory disease, that its presence was founded on, in doubtful cases, as an indication of the existence of inflammation.[1]

Occasionally, even now, we try to procure small quantities of blood for experimental or diagnostic purposes, as described in the section on gouty joints where Garrod's method of detecting uric acid is dealt with in detail (p. 126).

Minute quantities of blood for microscopic and other similar examinations, are always obtainable, without detriment to the treatment, of whatever kind this may be: fortunately it is in this direction that the most distinct advances have recently been made in the examination of the blood for the purpose of diagnosis.

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[1] This subject is discussed in physiological works. See especially the researches on the coagulation of the blood by Lister and others.

The presence of an excessively large proportion of colorless corpuscles in a drop of blood drawn from a patient constitutes the condition now known as *Leukæmia*. This condition in its most striking form is usually associated with evidence of changes in the spleen or in the lymphatic glands of the patient (Splenic and Lymphatic Leukæmia: see also p. 120). But the relative numbers of the white and red corpuscles vary greatly in different persons, at different times, within the limits of health; in various diseases the proportion is likewise seriously disturbed, so that much care is required in formulating a diagnosis based on an apparent increase of the white corpuscles; in anæmic conditions and in cancerous affections, in particular, the white corpuscles are often increased. In preparing a specimen for microscopic examination we usually prick the skin of the finger suddenly by means of a sewing needle, and occasionally it is better to produce congestion of the finger beforehand by the moderate compression of a ligature. We place the drop of blood on a perfectly clean slide and apply a cover glass, taking care to avoid the soiling of the glasses by any exhalations from the skin of the patient or of the observer, and also avoiding any pressure likely to damage the corpuscles. The drop of blood, indeed, may with advantage be received on the under surface of the cover glass, held with a pair of forceps, and the cover glass may then be slipped very gently down on to the microscopic slide; we aim at having just enough blood to fill the space between the two. The red corpuscles usually tend to run into *rouleaux*, and the white blood corpuscles may generally be easily recognized from the difference of their shape, their somewhat larger size, and their want of color; their granular appearance also favors their recognition. The actual number of white blood corpuscles visible in the field may then be counted, and in noting the result we should name the power of the microscope, specifying the number or the focal distance of the objective and the maker of the instrument; or we may attempt to estimate the proportion of the white to the red corpuscles by counting both in a given part of the field, noting 1—40, 1—20, 1—10, or 1—2, &c., as the case may be. We should always estimate several different microscopic "fields" before arriving at an opinion, and it is very desirable also to have more than one specimen of blood to avoid accidental fallacies. The figures named above indicate the results frequently obtained in cases of disease: the normal proportion of the white to the red corpuscles is very much less.

But such methods of enumeration are confessedly rough, and very subject to accidental variations. A more accurate determination demands the actual counting of the corpuscles of both kinds in a quantity of blood of known volume. In order to facilitate this, tubes and slides have been devised by Malassez and others. A capillary pipette (Potain's) is so constructed as to allow one volume of blood to be diluted with a hundred volumes of a 10 per cent. solution of sulphate of soda. This mixture not only dilutes and facilitates the subsequent enumeration, but it also prevents coagulation. Malassez has also devised a flattened capillary tube fixed in a microscopic slide, carefully adjusted to indicate a definite cubic capacity for a given length — these relations being marked on the glass slides: *e. g.*, 400 micro-millimeters represent $\frac{1}{169.8}$th part of a cubic millimeter, and 500 represent $\frac{1}{135.9}$th part, as determined by the instrument-maker. With such an arrangement it is evident that all we require is some means of measuring the micro-millimeters (each of these is equal to $\frac{1}{1000}$th part of a millimeter, and is often indicated by the Greek letter μ). This is best done by means of an ocular micrometer, divided into small squares, the exact value of which may be determined once for all by a stage micrometer, an adjustment of the one micrometer to the other being made by drawing out the tube of the microscope to a certain point which may then be marked; we can thus make the divisions of the ocular micrometer correspond in some definite proportion to those of the stage micrometer. In this way, by counting the corpuscles in a definite number of the squares we can estimate their actual number in a definite fraction of a cubic millimeter, and on multiplying by a hundred, for the dilution used, we obtain the figure wanted.

Another plan is to use the same method of diluting the blood (at least if small quantities only are available), but instead of using the special slide of Malassez just described, Hayem and Nachet employ a slide having a glass ring, $\frac{1}{8}$th of a millimeter in depth, cemented on its upper surface. A drop of the mixture, not enough to fill the cell so formed, is placed in the middle of the ring, and a perfectly flat cover glass is so laid on that the drop touches and adheres to it without reaching the sides of the cell. If a square area of ⅕th of a millimeter be selected, we have of course ⅕th of a cubic millimeter of diluted blood ready for our enumeration by means of the ocular micrometer ruled in squares as before.[1]

By such a method we can state the actual number of white and red corpuscles in a definite volume of blood, or if we prefer doing so, we can give the ratio of the one to the other with great accuracy.

In examining the white corpuscles as to their number we should also notice any peculiarity in their size. This is most easily judged of by comparison with the red corpuscles. In certain cases of leukæmia the white globules are of the usual size, but at other times they are smaller than natural, and a mixture of large and small white corpuscles may sometimes be seen. (See illustrations in Bennett's work on Leucocythæmia.) No definite significance can as yet be safely attached to these variations in size, but the facts ought to be recorded when ascertained.

The red corpuscles may be estimated as to their absolute number in a definite volume (say 1 cubic millimeter): a diminution in this respect has been found in cases of anæmia, and variations may also be noticed during the course of the treatment. Changes in the appearance of the red corpuscles are also to be observed; and any peculiarity or any deviation from the usual appearances ought to be noted, although such changes are generally due to evaporation and other physical causes (crenated margins, absence of the running together into rouleaux, &c.). More serious changes in the shape of the red corpuscles are sometimes seen, and have been figured, but these alterations probably arise from mechanical pressure in preparing the specimen. Increase in the size of the red corpuscles has also been observed in cases of anæmia.

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[1] For details and illustrations of the instruments see Schäfer's Practical Histology, p. 263 and 261. See also Rutherford's Practical Histology. The instruments are obtainable from M. Verick, 2 Rue de la Parcheminerie, Paris. Potain's tube for diluting and mixing the blood and the Malassez slide cost together 40 francs. Eye piece micrometers, with the squares ruled on the glass, may be obtained from the same instrument maker and others. A modification of Hayem and Nachet's method, with a slide prepared as above described, and also furnished with divisions ruled on it, after the manner of a stage micrometer, has been devised by Dr. Gowers, and may be obtained from Hawksley, instrument maker in London. (See *Practitioner*, July, 1878.)

Minute fragments of protoplasm are sometimes seen in specimens of blood: they appear as a somewhat granular-looking debris: they may result from rupture of the corpuscles while applying the cover glass; minute masses of this kind are sometimes found apart from this in fevers and various other diseases, but their significance is not great, or at least is not yet properly known.

Small colored cells, smaller than the red corpuscles, deeper in color, globular in shape and differing in their behavior with reagents have been observed in certain cases of Pernicious anæmia, and are figured by Eichorst in his work on this subject.

Another branch of the microscopic investigation of the blood has recently opened up a most interesting and important department of pathology. The existence of living organisms in the blood has now been established in several diseases. The earliest discovered and perhaps the most important organism of this class is that found in the disease known under the names of malignant pustule, splenic fever, anthrax, charbon, and other synonyms: the organism is found both in the human subject and in animals thus affected. This organism is a short, straight, motionless rod, about as long as the breadth of a blood corpuscle; it is named the *Bacillus anthracis*, and has been shown by experiment to be definitely related to the activity of the virus. (This bacterium resembles a very common and harmless one found in infusions of hay, &c., named the *Bacillus subtilis*, but this latter is endowed with motion.)

In relapsing fever organisms of another class are found in the blood during the paroxysm of the fever, and also in the relapse, but not in the apyretic interval. They consist of minute spiral fibrils of the most extreme tenuity, and the length is from two to six times the breadth of a blood corpuscle. They are named *Spirilla* (or by Cohn, *Spirochæte Obermeieri*): the spirals assume various forms in their combinations.

The *Filaria sanguinis hominis* (Lewis) may also be mentioned: it is found in the blood (and the urine) of persons affected with a certain form of chyluria, but as yet only in India and Australia. It is about the breadth of a blood corpuscle, and about $\frac{1}{75}$th of an inch in length, and exhibits active wriggling movements.

Another method of investigating the blood consists in determining its richness in hæmoglobin, from the depth of color presented by a dilution of known strength. For this purpose Potain's capillary pipette for mixing the blood is required, and the whole instrument may be procured from the maker who supplies Malassez's slide (see p. 284). The instrument is furnished with a scale for comparing the depth of color obtained with a definite standard, and a table supplies the estimate of the richness in hæmoglobin. By this means we are able to judge of the impoverishment of the blood in anæmia, and to trace the gradual improvement occurring, in favorable cases, under treatment.

CHAPTER X.

EXAMINATION OF THE FAUCES, LARYNX, AND NARES.

THE FAUCES.

In order to investigate the fauces and the parts in that neighborhood, it is necessary to bring the patient opposite a window or a lamp so arranged that the light will pass through the mouth to its posterior parts. If the patient be now made to open his mouth, it will sometimes happen that the fauces are at once visible. More frequently, however, the tongue interferes with the view; in its posterior parts, especially, it often mounts up, and, lying in contact with the soft palate, completely fills up the back part of the mouth. It is sometimes a little difficult to dispose of the tongue, but by varying the procedure according to circumstances the difficulties may generally be overcome. It is sometimes sufficient to close the nostrils of the patient so as to cause him to breathe through the mouth, for then the dorsum of the tongue must leave the palate in order to allow of the passage of air. Very often it is necessary to press down the tongue, and this may sometimes be done with the finger of the observer, but as a rule it is best performed with a spatula or the handle of a spoon. The best form of tongue depressor is a flat metal plate slightly curved, so as to give a hollow surface, fitted to adapt itself to the dorsum of the tongue. It is an advantage that the plate should have an oval aperture near its extremity, because the surface of the tongue will project through this, and by catching on the edges of the aperture prevent the instrument slipping. If the handle of a spoon be used, it ought to be a tablespoon, and one without any carving on it, as this only irritates the tongue, besides occupying space. The spatula, in whatever form it may be, should be pushed well back before being brought to bear on the tongue, and should then be pressed firmly downwards and forwards. The pressure should be steady and firm, and if the student practises on himself, he will have less difficulty when he comes to examine a patient.

When the tongue is thoroughly depressed a full view is obtained of the uvula hanging down and tremulous in the middle line; the soft palate arching to either side of the uvula, and dividing into two pillars, which appear as slight projections, one in front of the other; the tonsils, which in the normal state are hardly visible between the pillars of the fauces; and lastly, the pharynx, whose posterior wall is seen behind the uvula and soft palate. It is often possible by moving the spatula from one side of the tongue to the other to expose the pillars of the fauces and the tonsils more fully than by keeping it in the middle line.

In order to appreciate the changes which occur in the fauces, it will be necessary to familiarize one's self with the normal appearances. But this being premised, the principal points to be observed are these: The state of the uvula, whether it be unusually thick, and (what generally goes along with this), unduly motionless; whether it be altered in color, in the way of bright red or dark red, the former usually indicating a more acute and the latter a more chronic inflammation. Is there any exudation or ulceration on the uvula? Then as to the fauces proper, is the mucous membrane covering these parts thickened or reddened or ulcerated, or the seat of an exudation? Is there any enlargement or other change visible in the tonsils or their neighborhood? A systematic examination of each part with a direct view to determining the facts in regard to these various conditions will be of great consequence.

MORBID APPEARANCES IN THE FAUCES.—But now it will be well to give some indication of the conditions actually met with in certain of the commoner diseases. The commonest of all is *Catarrh*, in which, as a general rule, fauces, pharynx, and tonsils all take some part. If the disease be acute we will find the whole soft palate of a red color, and there is considerable swelling, especially of the uvula. The uvula is both longer and thicker than usual, the reason being, that as its tissue is looser and freer on all sides, the inflammatory exudation has more room to accumulate here, and the uvula may become quite plump and bulky. The pharynx is also seen to be red, and in certain stages of the disease it may be found covered with a mucous or muco-purulent secretion. The tonsils are for the most part swollen, and they project towards the middle line. In the chronic form of the disease the mucous membrane is of a duller red, and the swelling is less uniform. The uvula is elongated, thickened, and unduly rigid, but it has not the plump, bulky appearance of the acute disease, and some dilated veins may be visible on it. The mucous membrane of the pharynx is seen to be rough on the surface, from the thickening being irregular, and little projections occur at short intervals. There may be small superficial ulcers visible in this disease on the soft palate, tonsils, or pharynx.

In *Scarlet fever* the condition of the fauces is that of an acute inflammation, and the conditions presented are very like those just referred to. The uvula, palate, tonsils, and pharynx are generally, even in the mildest cases, red and swollen. The red and swollen mucous membrane is often covered with a layer of tenacious mucus, and in the more severe cases the tonsils may be so much swollen as almost to obstruct the fauces. All these processes are acute, developed in the course of a comparatively few hours. In the more severe cases there is more than a simple catarrhal inflammation. Instead of a layer of mucus on the mucous membrane, there appear specks and patches of a gray color, which seem to be adhering to the surface, although they can generally be removed without breach of surface. Along with this catarrh, as in simple catarrhal inflammation, superficial ulcers may form, which are not to be mistaken for the patches about to be mentioned. But sometimes there is actual sloughing of parts of the mucous membrane, and the sloughs coming away leave deeper irregular ulcers. This sloughing is, however, only met with in very exceptionally severe cases, and scarcely in the earlier periods. It is to be remembered that the condition seen in the throat may extend to parts which are invisible, especially to the posterior nares. Important elements in the diagnosis of the scarlet fever throat will be supplied, of course, by the state of the tongue, the rash on the skin, and the other indications of the specific fever.

In *Diphtheria* we have also an acute inflammation of the same parts, but the appearances presented are very different. The mucous membrane here is red and swollen, but the attention is very particularly called to the existence of a peculiar exudation on the surface. Instead of the tenacious mucus, there appear on, or one might almost say, *in* the mucous membrane of the fauces, specks and patches of a white color. These are mostly met with on the uvula and palate, but they are often seen on the surface of the tonsils and pharynx, and even in various parts of the mouth. The patches are at first white, but they soon get darker in color from dirt and blood. This white material really involves the mucous membrane as well as appearing on its surface, and the consequence is sloughing of the superficial layers of mucous membrane. The sloughs and exudations separate and fall off, hanging from the surface as shreddy, ragged masses. It should be remembered that the inflammation does not usually confine itself to the parts seen, but often extends down into the pharynx and larynx, and upwards into the posterior nares.

It is very important to be able to distinguish the exudation which is so characteristic of diphtheria from conditions of a different nature, and to judge from the frequency with which simple diseases of the throat are called diphtheria, the distinction does not seem to be very easy. All kinds of ulcers may be mistaken for diphtheritic patches, especially as they may be coated with a whitish secretion. Ulcers are met with in ordinary catarrhal inflammations, and these are most frequently seated on the soft palate, the tonsils, or the pharynx. Ulcers also occur in scarlet fever, and there they have similar seats. In smallpox also we may have ulcers and other evidences of acute inflammation in these regions, but the eruption on the skin will prevent any mistake being made. It should be remembered that the diphtheritic patch is an exudation on and in the mucous membrane, and is therefore raised above the surface, whereas an ulcer, of whatever kind, is depressed below it. There is a form of disease which resembles the exudation of diphtheria more closely than any other, but which can hardly be mistaken for it, and that is the condition found in the mouth and known as Thrush or Muguet. These patches often extend to the fauces, pharynx, and even further, and as the peculiar white appearance is due to an excess of epithelium united into a membrane by the threads of a fungus, the patch may have a superficial resemblance to that of diphtheria. But the existence of these patches on different parts of the mouth, and their characters on close inspection, as well as the general symptoms, ought to prevent any such mistake. The microscopic examination may also assist us, by revealing the presence of a vegetable parasitic growth. (See Fig. 30, p. 305.)

Phlegmonous Inflammation of the Fauces. Tonsillitis.—If this inflammation be acute, which it generally is at the first, one or both tonsils will be found much enlarged, projecting towards the middle line; their surface is coarsely nodulated, and often covered with a tenacious exudation. The mucous membrane of the entire fauces, and frequently also of the pharynx, has a dark red color. The enlarged tonsils can generally be felt by external examination, and the patients have usually a peculiar voice, as if they were speaking with something stuck in their throat. The inflammation often goes on to suppuration, and then abscesses form in the tonsils, and these may be seen before they have burst as smooth rounded projections from the general contour.

After these abscesses have burst the tonsils will be found still a good deal larger than normal, and they will present an irregular ragged appearance at the place where the suppuration has occurred. Sometimes suppuration takes place in other parts besides the tonsils, even when the acute inflammation has begun in the tonsils, and in these cases we may have abscesses forming in the soft palate or in the pillars of the fauces; but suppuration there is much less common than in the tonsils themselves. As these inflammations of the tonsils, whether they go on to suppuration or not, are very liable to recur, and often assume a more chronic form, subject to acute exacerbations, we often meet with patients with permanently enlarged tonsils. Such tonsils are hard and uneven on the surface, having often an appearance as if ploughed up by cicatrices.

Syphilis.—We have still to describe the appearances in syphilitic disease of the fauces. Syphilis may manifest itself here as a simple inflammation, presenting great resemblance to the catarrhal inflammation already described. The catarrh is more persistent, but apart from the history nothing may indicate its specific origin. In other cases, however, the disease is followed by extensive ulceration. Before the ulceration begins there is swelling of the mucous membrane, and there may even be more defined tumors visible (gummy nodules). The ulcers which form are usually situated on the soft palate or uvula, but may attack the pharynx. They generally cause considerable destruction of the mucous membrane, and in this way it is not uncommon to meet with cases in which the soft palate and the uvula are eaten away in great part. The loss of the soft palate will cause the person to have a peculiar nasal voice, and his pronunciation of certain letters will be imperfect, because he is unable to close the nares during phonation. Almost the only disease likely to be confused with this is cancerous disease with ulceration. If it be remembered that in syphilis there is always some other indication of specific disease, it is hardly possible to make a serious mistake.

Retro-Pharyngeal Abscess.—It is necessary to bear in mind that abscesses occasionally form behind the pharynx, between it and bodies of the vertebræ, retro- or post-pharyngeal abscesses. The abscess presses forward the mucous membrane of the pharynx, which may be seen bulging forward, or felt as an elastic tumor behind the soft palate, and sometimes it forms a serious obstruction to respiration and deglutition. The abscess generally originates in disease of the vertebræ, but may have other causes, especially in children. Abscesses originating in the vertebræ sometimes point externally in the neck.

The elucidation of many of the matters above referred to may often be facilitated by the use of the finger. The state of the tonsils, for instance, or the consistence of any swelling can be thus explored; while, at the same time, information is gained as to the state of sensitiveness of the part. It is often useful to assist the internal exploration by using the other hand outside, so as to place the tissues between the finger inside and that outside.

THE LARYNX.

LARYNGOSCOPE.—The examination of the larynx is not a difficult process, but one which requires a certain amount of practice, patience, and tact. Before detailing the various steps in the procedure, it may be well to refer to certain matters connected with light and instruments. It is necessary to be provided with a lamp of some kind, and as it is important that the light should be near the level of the patient's mouth, the lamp must be capable of being raised and lowered. It is also well, where possible, to surround the flame with an opaque tube open only at one side, because this enables one to have the room dark, and the apparent intensity of the illumination is thereby increased. A convenient form of gas lamp is that used in the London Hospital for Diseases of the Throat, and now adopted in many institutions. It consists of a gas bracket in two parts. The part next the wall consists of two parallel tubes, so arranged that in elevating and depressing the bracket, the *other* part, which is jointed to this, remains horizontal. In this way the flame is always in the perpendicular in position. The gas burner is an Argand, and instead of the ordinary glass funnel, it is provided with a metal cylinder, into one side of which, at a level corresponding with the flame, is fitted a strong plano-convex or bull's-eye lens. The effect of this is that, while no light escapes except from one side, the light escaping here has its rays rendered nearly parallel, and it can be brought to bear much more powerfully on any given object. The student may make use of any lamp which gives a bright light, and which can be raised or lowered as desired.

We require, in the next place, some apparatus for concentrating the light on the patient's fauces. It is not well, as a rule, to do this by the direct light of the lamp; a concave mirror having a rather long focus is the most convenient arrangement. In order that the hands may be free, it is requisite to have this mirror fixed to the head in some way or other. This is done in various ways, the two commonest being a strap round the head, and a spectacle frame. The present writer has been in the habit lately of using the latter, and finds, among other advantages, that the ease with which it can be put off or on renders it very convenient. Whichever method of fixing be used, the reflector should be worn over one eye, in such a position that the eye which is covered by it can look through the hole which should always exist in the centre of the reflector. (It is not sufficient to have clear glass in the centre, but the reflector should be actually perforated.) The reflector should be placed over the eye nearest to the lamp, and in such a position that while this eye is protected from the light of the lamp, the shadow of the reflector, projecting a little to the other side of the ridge of the nose, will screen the other eye from the glare of the lamp. If, for instance, the lamp be placed to the right of the observer, then the reflector will be placed over his right eye. The right eye, while protected from the lamp, will be able to look through the aperture at the patient, and the left eye will be shaded by the edge of the reflector, but will be free in other directions.

The laryngeal mirror is a small mirror mounted on a stem, and intended to be placed in the fauces of the patient, so as to catch the light and direct it down to the larynx, and at the same time reflect the image of the larynx towards the eyes of the observer. The observer should be provided with mirrors of different sizes, and he should see that the stem passes off directly from the border of the mirror, there being serious objections to the arrangement by which the wire forming the stem is carried a certain distance out from the mirror before being turned down to form the stem.

We may now turn to the procedure in the actual examination of the patient. In order to appreciate the difficulties of this process and to understand the mechanism, it is strongly to be recommended, that the student will begin by practising on himself. A short paragraph on Auto-Laryngoscopy will be added to this description. For an ordinary examination the patient and observer should be seated on two chairs facing each other. The lamp may be conveniently placed to the patient's left; it ought to be about the level of his ear, and as near his head as may be convenient. The observer, with the reflector over his right eye, moves the reflector till the bright light falls on the patient's face. He then asks the patient to open his mouth, and observes that the head is so placed that the rays of light can find free access to the fauces. Frequently the head is bent to one side or the other, and this should be rectified. The patient should also be made to sit straight up with the neck somewhat stretched, and the head inclined backwards. Before proceeding further all these points should be noted and a full illumination of the mouth obtained. At this stage it will often be impossible to see the fauces, because the tongue obstructs the view, and it is necessary in the next place to get it disposed of. It is not sufficient here to depress the tongue with a spatula, because when the laryngeal mirror is introduced, the back part of the tongue will probably be raised, and spatula and dorsum pushed against the mirror. It is most convenient to ask the patient to put out his tongue, and to catch it with the finger and thumb of the left hand, a napkin being used for purposes of cleanliness, and also to prevent the organ slipping from the grasp. The tongue should simply be taken hold of, it should not be dragged forward, all that is wanted being to prevent it slipping back and the dorsum mounting up against the soft palate. The tongue being thus secured, a full view of the fauces should be obtained, and it is well to be sure of this view before proceeding further.

The next procedure is the introduction of the laryngeal mirror. It should be slightly heated before being introduced, otherwise the breath condensing on it dims the surface. It is best heated by placing it over the lamp, and it should be held with the surface of the mirror downwards so that the surface can be seen. The vapor produced in the combustion of the lamp at first condenses on the surface, but as the temperature rises the vapor is cleared away, and the mirror resumes its brightness. When this has occurred it is ready for introduction; but before introduction, the back of it should be applied to the skin, say of the left hand, to see that it is not too hot. The patient will see you apply it to your own skin, and will not dread that he is going to have his throat burned. The tongue being held in the left hand, and the fauces continuously illuminated, the heated mirror is now to be introduced into the mouth, and in doing this the right hand will be kept to the right of the middle line, and slightly below the level of the mouth, so as not to come between the lamp and the eyes of the observer. The mirror is passed backwards, keeping its surface parallel with the tongue, and taking care not to touch any of the structures in the mouth with it. It is so introduced that the stem lies in the left half of the mouth, coming out near the left angle. The mirror is kept in the middle line, and is pressed against the uvula, which it pushes backwards and upwards towards the posterior nares. The instrument should be held delicately, but steadily, in the hand. Any tremulousness has the effect of tickling the fauces, and is apt to bring on reflex efforts at vomiting, which necessitate the withdrawal of the mirror. Just as the mirror is being placed, the patient should be asked to say "ah," and the instrument should be pushed home while he is doing this. The effect of pronouncing this vowel is, that the mouth is at once fully opened, and the uvula drawn somewhat up.

The first object to come into view is the back of the tongue with its large circumvallate papillæ. Then the tip of the epiglottis will be seen, and it is probable that for some time the beginner will see little more. By carefully adjusting the mirror, however, and by asking the patient to say "ah," the movements of the laryngeal structures will by and by attract the eye and suggest such changes in the position of the observer and of the mirror as to bring the interior of the larynx itself into view. As a general rule, the mobile arytenoid and associated cartilages will come first into view immediately behind the epiglottis. By inclining the mirror more downwards, the vocal cords may be exposed as two pearly-white bands extending from the arytenoids forward as if into the base of the epiglottis. The great difficulty in the way of obtaining a full view of the vocal cords is the epiglottis, which often hangs down so that only the arytenoid cartilages, and sometimes not even they, can be seen behind it. Something may be done to raise the epiglottis by having the tongue well protruded, the glosso-epiglottidean ligaments pulling the epiglottis upwards. A great deal may also be done by asking the patient to say "a" (as in *hate*), for the pronunciation of this vowel causes the base of the tongue to be brought forward. It is impossible to say "a" with the mouth open, but an approach to it will be made, and in the effort the epiglottis will be raised. It is generally possible by this means to get a view of the cords even to their anterior extremities. But sometimes even this fails, and it is necessary to use a further method. The epiglottis is most fully raised in enunciating the vowel "*e*" (as in *me*), but with the mouth open and the tongue held out it is impossible even to attempt to say "*e*." If the patient be asked, however, to say "*ah*" "*e*" (as in saying *aye* slowly and prolonging the *e*), the mere attempt to pass from the one vowel to the other will result in a pulling up of the epiglottis. This will generally be successful in the worst cases, but it is, of course, only a glimpse that one gets while the actual phonation is in progress.

Next to the difficulty with the epiglottis, the most serious obstacle to laryngeal examination is the tendency to retch which many patients present when the mirror is placed in the fauces. There are very great individual differences in this respect, and the difficulty can only be overcome by patience. It is sometimes necessary to ask the patient to tickle his fauces frequently with a feather, in order to accustom them to the contact, and after a few days they generally get sufficiently non-sensitive. When the straining efforts set in, it is necessary to withdraw the mirror, as the pharynx contracts and completely closes the view; and, besides this, whenever retching has occurred, it is generally impossible to get a good view at that sitting. If the fauces are very exceptionally sensitive, the best plan is to cause the patient to suck ice for about ten minutes before the examination.

AUTO-LARYNGOSCOPY may be practised in various ways. A very simple plan is that of Dr. Foulis, in which a globe filled with water is used to condense the light, and a little piece of looking-glass is placed above this condenser to enable the image to be seen. The globe may be had in a glassblower's, and is of the kind used by jewellers to concentrate light on their work. It is mounted in a simple way on a candle-stick, and placed in front of the light. The observer sits in front of it, allows the light to fall on his fauces, introduces the mirror after heating it, and observes the image in the piece of looking-glass above the condenser. Another simple method is for the observer to seat himself with the lamp in the same relation to him as it would be to a patient. Then in front of him are fixed the ordinary laryngeal reflector held in some kind of stem, and side by side with it a small toilet-mirror or hand-glass. The light coming from the lamp is reflected on the fauces just as in the case of a patient, and the image is seen in the mirror or hand-glass. A very ingenious method is that of Dr. George Johnson, and perhaps it is the best, as it needs no special apparatus. The observer sits down in front of an ordinary looking-glass, which has a lamp placed at one side. He puts on the ordinary reflector, and so manipulates it that he illuminates his fauces, as seen in the looking-glass, as if it were the fauces of a patient, and when this has been done, introduces the laryngeal mirror into his own fauces as before. The objection to this method is that the image being twice reflected is not very clear, but it approaches much more closely to the examination of a patient than either of the others. If the looking-glass be a thoroughly good one, and its surface well cleaned, this method presents little difficulty.

It is impossible here fully to describe the appearances presented by the normal larynx, these should be made familiar by practice; but we must refer to the principal points which ought to be taken particular notice of. The laryngeal mirror reveals the mucous membrane over the small cartilages at the back of the larynx, the arytenoids, and the cartilages of Santorini and Wrisberg. The general contour of these cartilages as well as the appearance of the mucous membrane should be noticed. Then the aryteno-epiglottidean folds which form the lateral borders of the upper opening of the larynx, can be seen passing obliquely backwards from the epiglottis. At the bottom of the larynx the true cords attract attention, appearing as flat pearly-white bands which are very mobile, and during vocalization come close together. Above the vocal cords and parallel with them, but separated by a space, are the ventricular bands which are often called the "false cords." They are folds of mucous membrane running in a direction from before backwards. Between each band and the corresponding vocal cord we can generally see a slit, this is the opening of the ventricle of the larynx which forms a shallow pouch, nothing of which is seen except the slit-like opening.

The introduction of the finger may sometimes supply us with a good deal of information as to the state of the larynx, where laryngoscopy is difficult, inconvenient, or not available. The index finger should be introduced at the angle of the patient's mouth, the other fingers being semi-flexed, and the hand lying against the patient's cheek and lower jaw. The fork between the index and middle fingers will soon come against the angle of the mouth, but by pushing the hand along the cheek the angle of the mouth can often be considerably stretched backwards towards the angle of the lower jaw. By directing the index finger along the edge, and past the dorsum of the tongue, the upper edge of the epiglottis and the neighboring parts can be distinctly felt. Any roughness or thickening of the epiglottis can thus be distinguished, and also any swelling of the aryteno-epiglottidean folds. Ulceration or tumor of the larynx may likewise be recognized in this way.

MORBID APPEARANCES IN THE LARYNX.—The student, having made himself familiar with the normal appearances of the larynx, will be prepared to attempt the investigation of morbid states. A laryngoscopic investigation will be undertaken whenever anything directs special attention to the throat. If there is any change in the voice, any hoarseness, or even a slight variation from the usual tone as appreciated by the patient's friends; if there is any pain either spontaneous or occasioned by speaking, swallowing or on handling the larynx; if there is a cough which is not accounted for by the state of the lungs, and which may have its origin in the larynx; in all these cases an examination of the larynx will be called for and should be undertaken. It will not be possible to do more than indicate very briefly the appearances presented in certain of the more common diseases of the larynx.

In acute *Catarrh* there may be considerable thickening of the mucous membrane, and this thickening will in great part be due to inflammatory œdema. It is not usual, however, to have extreme thickening in simple catarrh, although the possibility of it must not be lost sight of. The mucous membrane will be red, and the redness will be somewhat bright. In chronic catarrh there is a more permanent thickening of the mucous membrane, and its color is deeper than that of the normal larynx. The thickening may be no more than to obscure the outlines of the cartilages in the posterior parts of the larynx, and to make the ventricular bands more prominent. But it may assume very great proportions, and in some cases the mucous membrane and submucous tissue develop such a quantity of dense connective tissue that the larynx is greatly contracted and the structures deformed and rendered rigid. Sometimes the thickening so affects the aryteno-epiglottidean folds that they stand out as rounded prominences and form very conspicuous objects. In severe cases ulcers generally form, but these are mostly superficial and are not nearly so prone to attack the vocal cords as in other forms of ulceration. Of course in acute catarrh there will be profuse expectoration, while in the chronic form there will be an expectoration of small quantities of tough mucus. It should be added that catarrh of the larynx, whether acute or chronic, is very often associated with catarrh of the fauces and pharynx, for the appearances in which see p. 288.

In *Phthisis* of the larynx, there is a chronic catarrh, but it is not accompanied with great thickening, and the most marked appearances are those due to ulceration. The ulceration may be confined to one side, or at least it is generally more pronounced on one side than the other. It usually begins in the posterior parts, very often just at the posterior extremities of the cords, and it attacks the vocal cords pretty early. When small the ulcers are not very marked, and are most readily recognized by the ragged edges which they commonly present. There may be very extensive superficial ulceration, even extending up the epiglottis, and sometimes the ulceration induces deep disease of the cartilages. In these cases there is hoarseness or loss of voice, and as the ulceration generally attacks the cords early, the change in the voice is usually an early symptom.

In *Syphilis* we may have a catarrh of the larynx not distinguishable in its appearances from ordinary catarrhs. Occasionally condylomata or mucous patches occur, and may be seen as definite tumors on the cords or elsewhere, or as flat prominences. Syphilitic ulceration is not very common, but sometimes it is very extensive. No other form of disease produces such extensive destruction of tissue, and this destruction may involve neighboring structures.

Inflammation of the cartilages of the larynx or rather of their perichondrium may be at the basis of a chronic laryngeal catarrh, or even of an acute catarrh. In this disease, however, there is much greater pain, especially on handling the larynx.

In *Croup* and *Diphtheria* we are seldom called on to examine the larynx, as the disease is sufficiently obvious on other grounds; but if we are, the white exudation coating the mucous membrane will be visible. Here the exudation is not involved in the mucous membrane, as it is in the mouth and fauces, but lies on its surface, and comes away without ulceration.

Œdema glottidis must also be referred to in this place.

This is a condition which may supervene on any acute inflammation of the larynx. It is met with, but not commonly, in acute catarrh. It occurs in the laryngitis induced by the pustular eruption of smallpox which very often spreads to the larynx. It may be the consequence of syphilitic or tubercular disease, and sometimes supervenes on inflammation of the cartilages, or it may be a concomitant of erysipelas. The fluid accumulates in the submucous tissue of the larynx, the œdema being generally the consequence of an acute inflammation of the mucous membrane. Just as in œdema of the skin the fluid accumulates most where the subcutaneous tissue is loose, so here the œdema is greatest where the submucous tissue is loose. The mucous membrane of the larynx is mostly bound down pretty firmly to the subjacent structures, it is loose over the epiglottis, but especially in the aryteno-epiglottidean folds. Accumulating there, the fluid swells up the mucous membrane; the epiglottis is often very prominent, and the aryteno-epiglottidean folds form prominent rounded tumors. It is these latter which obstruct the larynx, and it is generally easy to reach and incise them with the aid of the laryngeal mirror. The vocal cords are not affected at all.

Growths are not uncommon in the larynx, and they are often situated on the vocal cords. If this be the case they alter the voice, usually making it hoarse. If the growth be on the cords it is easily seen, elsewhere it is not so distinct, especially if it be small. Most of these tumors are simple in their nature; but sometimes sarcomata or cancers attack the larynx, especially the latter. Cancers are mostly epithelial here, and as these commonly ulcerate we may have considerable loss of substance, as well as great alterations from the extension of the disease.

Paralysis and Spasm of the vocal cords—Alterations in Cough and Voice. If the patient cannot speak above a whisper, and the vocal cords are normal in appearance, then there must be paralysis. The paralysis may be of central origin, as in cases of hysteria and loss of voice from fright. In that case the cords may be seen to move pretty freely during inspiration, but on attempting to vocalize they are not tightly stretched, and do not come *closely in contact*. It often happens that such patients can cough well enough, and it can then be seen that the cords approximate perfectly. In cases which have recovered from diphtheria there is often a paralysis of the vocal cords, which is frequently associated with paralysis of the soft palate, and it may be of the pharynx. Of great interest are the paralyses which are traceable to interference with the nerves supplying the laryngeal muscles. These are mostly unilateral, although it is not impossible for the nerves on both sides to be coincidently involved. Aneurisms of the aorta often involve the recurrent laryngeal nerve of the left side. As this nerve supplies all the intrinsic muscles of the larynx, these will be affected if the nerve is involved. The aneurism may irritate the nerve, and bring on spasm of the muscles. The spasm appears to extend readily to all the muscles of the larynx, so that violent suffocative attacks occur from the vocal cords being forcibly closed, and the patient may die in one of these attacks. The pressure on the nerve, on the other hand, often induces paralysis, and this paralysis will be unilateral. It may be a very slight paralysis; the patient is not able to keep his glottis firmly closed during the violent expiratory effort of coughing, and so the cough has a peculiar sound, a clang due to the cords being brought together, but going violently apart before the violent pressure of the air behind. In this case laryngeal examination may detect little. The cords may be approximated during vocalization, but the left one may be seen to move more sluggishly than the right. In these cases the voice is altered, it may be hoarse or peculiar, but not generally reduced to a whisper. Sometimes complete paralysis supervenes. In that case the cough is not clanging, but a loud rush of air is heard as if through a moderately narrow aperture. The voice is reduced to a whisper, and with the laryngoscope it can be seen that the left cord is paralyzed. During vocalization, it does not come forward to meet its fellow, but lies motionless, and the right cord, not being met, projects beyond the middle line. Apart from aneurisms, similar results may be produced by tumors or other morbid conditions interfering with the nerves in their course. Phthisis pulmonalis may, by affecting the pleura and neighboring structures, involve the recurrent nerve, either on the right or left side. The tumors which mostly interfere with the recurrent nerve are those in the chest, but it may be involved in the neck as well, or the pneumogastric may be attacked before it gives off the recurrent. It will be remembered, further, that spasm of the glottis is a *comparatively* frequent affection in children; this condition is known under the name of laryngismus stridulus, and it also occurs in whooping-cough and bronchial phthisis.

INVESTIGATION OF THE NARES.

Rhinoscopy consists in the inspection of the nares; this may be done by inserting a mirror behind the uvula, with its surface so placed as to reflect the image from the posterior nares. The mirror must be a small one, not more than five-eighths of an inch in breadth, and it should be bent so that its surface is at right angles with the stem. It is generally necessary also to use a tongue spatula, which should be introduced further back than usual. The patient sits with his head erect, or slightly bent forward, and the light of the lamp is to be reflected on the fauces exactly as in laryngoscopy. The tongue having been depressed with the finger or a spatula, the mirror, after being heated, is introduced into the back of the throat, and placed so that its surface forms with the horizon an angle of 130 degrees. The mirror may be conveniently introduced first on one side of the uvula and then on the other, so that an image may be obtained of the two posterior nares separately. The uvula often obstructs the view, and so does the soft palate, if the distance between the anterior pillars of the faucess and the wall of the pharynx be too short. A hook has been devised for raising the uvula, but it is in most cases of doubtful utility. The image obtained is at first rather difficult to understand, and especially so, as it is impossible to get a full view of the posterior nares at once, and it must be taken piecemeal. The most prominent appearance is the middle turbinated bone; below it, is the inferior, and above it, somewhat in the distance, the superior. The septum is also to be seen; and, by moving the mirror, the trumpet-shaped extremities of the Eustachian tubes. It must be confessed that the examination is often unsatisfactory; and those who desire to follow it out more fully should consult some of the special works, such as that of Morell Mackenzie on the Laryngoscope.

The anterior nares may be examined by causing the patient to bend his head far back, and then directing the light by means of the reflector into the nostrils. The nostrils may be dilated with a blunt probe, or other means. A spatula has been devised for dilating the nostrils, and so exposing the anterior nares.

Rhinoscopy will be called for when the existence of a chronic discharge from the nares, or a persistent obstruction, directs special attention to these parts. Sometimes, also, the condition of the openings of the Eustachian tubes in deafness may be discovered by means of rhinoscopy. When a view of the nares is obtained it may be possible to observe any undue redness, or thickening of the mucous membrane, the existence of ulcers, the proximate source of discharges, &c. The existence and exact seat of polypi, which frequently obstruct the passage, may also be discovered by this means.

For descriptions of the methods of examining the Larynx and Nares reference may be made to the works of Morell Mackenzie, Prosser James, Cohen, and Lennox Browne; the last gives numerous colored illustrations of the appearances seen in the larynx. See also the work of Sir Duncan Gibb, and the article on the Larynx in Reynolds's System, Vol. III., by Morell Mackenzie.

Croup, Diphtheria, Scarlatina, Retro-Pharyngeal Abscess, &c., are discussed very fully in works on the Diseases of Children.

CHAPTER XI.

DISORDERS OF THE DIGESTIVE SYSTEM.[1]

THE Digestive Organs are much deranged in a great many diseases of a general nature, as well as in local affections of these organs themselves; an inquiry into their state constitutes an important part of nearly every case as a matter of diagnosis; but, perhaps, the prognosis and treatment depend even more particularly on this investigation. Fevers and inflammations of nearly every kind affect the digestive functions more or less seriously, and many cerebral and other nervous disorders likewise do so; general constitutional diseases, anæmia, Addison's disease, leukæmia, &c., also disturb them more or less profoundly. Affections of the kidney, uterine disorders, and pregnancy, frequently declare themselves first by vomiting: and, of course, diseases of the œsophagus, stomach, bowels, liver, pancreas, peritoneum and mesenteric glands, necessarily derange the digestive functions; affections of the digestive organs may be either primary, or perhaps the secondary effects of mischief in contiguous organs (aneurisms, abdominal tumors, &c.)

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[1] General Treatises on Medicine may be referred to for affections of the Stomach, Bowels, &c. See especially Reynolds's System, Vol. II.

Infantile Diarrhœa, Dentition, and some other disorders referred to in this chapter are discussed more fully in Treatises on Diseases of Children; see West, Lewis Smith, &c., and also Eustace Smith on the Wasting Diseases of Infancy.

Regarding the Stomach, Indigestion, &c., see Wilson Fox, Chambers, Pavy, Brinton, Habershon, and Fenwick. Brinton's book on Intestinal Obstruction is also very valuable; see also Hilton Fagge in *Guy's Hospital Reports* for 1869, on the same subject.

Cobbold on Entozoa, Murchison and Frerichs on Diseases of the Liver, Bright on Abdominal Tumors, and Habershon on Diseases of the Abdomen, may also be referred to.

Regarding the Teeth and Gums, see special works, such as those of Coles, Wedl, and Garretson, and the chapters on these subjects in Holmes's System of Surgery, and Reynolds's System of Medicine. Hutchinson's Memoir on Inherited Syphilis is also very important in this connection.

Many disorders connected with the Mouth, Œsophagus, and Rectum, are treated of more fully in surgical works, and these must be frequently referred to. Holmes's System, from the fulness of its articles, is particularly valuable to the physician in this respect.

This complexity in the etiology of digestive disorders necessitates a very careful investigation of the different groups of symptoms; each particular disorder has often to be scrutinized in respect of the duration, the proximate cause, and the relative date of the symptom in question.

The appetite is usually more or less impaired (Anorexia) in all serious diseases, especially in those with high fever or other acute symptoms, and in those which involve the digestive organs in a direct manner. We should ascertain the habitual character of the appetite in health; we also inquire whether there is any remaining desire for particular kinds of food, and what these are, whether the appetite is capricious as to special kinds of food or abnormal articles, or at different times; whether the loss of appetite is associated with nausea or loathing of food; and whether actual sickness and vomiting occur on attempting to overcome this repugnance. Many influences not usually thought of as diseases are often at work in causing impaired appetite; grief or anxiety and depression of spirits, want of company at meal times, want of fresh air and exercise, the use of certain drugs, including opium, chloral, and alcohol (even in medicinal doses), are often responsible for the want of appetite complained of by our patients. In some forms of nervous disease there is an inordinate appetite arising from a sense of want or emptiness, even very soon after a meal; and in Diabetes also, the appetite is often excessive. In certain states of bodily and mental disorder an unnatural appetite (pica) for the most extraordinary articles may sometimes be noticed (Chlorosis, Pregnancy, Insanity. Compare Chapter viii., p. 231).

Thirst is a very frequent complaint in all diseases associated with much pyrexia; in such cases, notwithstanding the quantity of fluid consumed, the urine is usually scanty. In several forms of stomachic derangement also, the presence of thirst is a frequent symptom, and in such cases the urine may be abundant although otherwise normal. In certain forms of Bright's disease, and particularly in diabetes, the complaint of thirst often directs our attention to the examination of the urine, and in such cases the consumption of a large quantity of fluid is usually found to be associated with frequent micturition and the passing of a large quantity of urine; the further examination brings out abnormalities in the specific gravity, and also as regards the presence of albumen or sugar. Particular articles of diet (salt fish, &c.) often cause temporary thirst, and the use or abuse of alcohol is frequently followed by more or less thirst and dryness of the throat, especially in the morning.

THE STATE OF THE TONGUE

affords valuable indications respecting the digestive functions, especially when the disorder is due to the influence of constitutional disturbance (the presence of febrile and inflammatory disease). Indeed, the progress of a febrile attack can often be traced both in its increase and deline by corresponding changes in the state of the tongue. (For various matters concerning the innervation of the tongue, including articulation, see pp. 148, 162, 164, 175.)

The presence of a fur or coating on the tongue should be described as to its extent, whether the edges and tip are clean, and as to the color and thickness of the fur which is sometimes very dense. Different from the ordinary coatings of digestive disorder are the white soft patches of Muguet (Parasitic Aphthæ or Stomatitis, popularly known as "Thrush," "Frog," &c.); these are often seen in children, especially in those who are fed artificially; but they may likewise occur in others, and even in adults suffering from chronic diarrhœa and exhausting diseases approaching a termination; these white spots and patches are found als

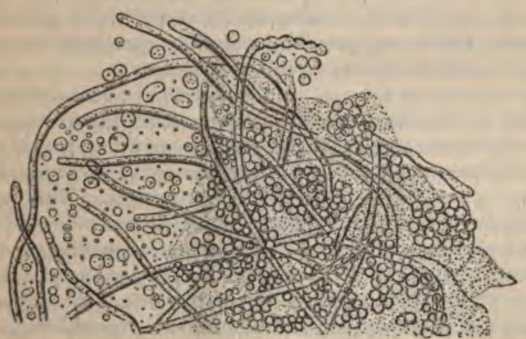

Fig. 30.—*Oidium Albicans*, the vegetable parasite of *Muguet* or *Thrush* (Reduced from Ch. Robin.)

on the mucous membrane of the cheek and throat; they are due to the presence of a vegetable parasite (Oidium albicans, see Fig. 30), which may be seen with the microscope, after removing such spots with the point of a knife and digesting them in liquor potassæ. (For distinction from white diphtheritic patches, see Chapter x., p. 290.) Very much rarer than this is the presence of a black parasite, seen occasionally in cases of phthisis and some other diseases. The dark streaks on the tongue and buccal mucous membrane observed in Addison's disease, form part of a general pigmentation.

The dryness of the tongue is the next point to be considered. This may be tested by applying the tip of the finger to it as well as by looking at it. The dryness may exist either with or without coating. In advancing typhus, pneumonia, surgical fever, &c., we often find the tongue becoming dry, brown, and hard, so as to be not unlike roasted leather. Along with this we often see sordes on the gums and teeth. In less severe or receding forms of the same condition, the dorsum may be dry and the edges and tip somewhat moist. But the tongue may be dry in whole or in part without much, if any, fur, in which case it has a red glazed appearance; or, if some parts are less dry than others, we may see streaks here and there, and perhaps small patches of fur on the dorsum; this state is not unfrequently complicated with hacks or cracks, often very painful; a similar condition frequently can be traced further back in the fauces.

The red raw tongue is seen in certain febrile states (especially enteric and scarlet fevers); this may succeed the intensely furred condition already referred to; the whole of the thick coating sometimes disappears with great quickness, leaving a very red moist surface exposed. This sudden desquamation is scarcely so favorable as a slower and more gradual cleaning. This red raw tongue, in such a case, may become dry and glazed in the further progress of the fever.

The "Strawberry tongue" is characterized by great distinctness of the papillæ, associated with considerable redness, and not unfrequently with thick white fur in adjacent parts. This strawberry tongue is common in scarlet fever, not usually at the very beginning, but after some days' continuance of the fever.

Enlargement of the circumvallate papillæ, at the back of the tongue, is not uncommon in cases characterized by various dyspeptic symptoms, and often associated with a pitted condition of the tonsils.

Little blisters on the tongue (aphthæ), and various degrees of ulceration, supply the evidence of the different forms or degrees of stomatitis (vesicular, ulcerative, gangrenous): these are often associated with salivation, fetor, and much febrile disturbance.

A swollen, sodden appearance of the tongue with very distinct indentations on the edges, corresponding to the teeth, is often found in dyspepsia of various kinds, including those connected with the free use of alcohol. Swelling of the tongue from *salivation* by mercury or iodide of potassium occasionally occurs; the rest of the mouth participates in this action: the mucous membrane of the cheek opposite the teeth should also be examined, and the smell of the breath likewise. Glossitis (from this or other causes) may lead to swelling of the tongue, and this may be so great that the tongue cannot be kept within the mouth.

Swellings under the tongue (ranula), and hardness or nodulation from syphilis and cancer, belong rather to surgery than medicine.

Nearly all of these last named alterations, associated with swelling or enlargement of the tongue, may lead to difficulties in speaking and swallowing; they sometimes render eating or drinking painful or impossible.

Paleness of the tongue from anæmia, *lividity* in cyanosis, *coldness* in cholera or collapse, and patches of *ecchymosis* in purpura, are further points of an obvious character which should be noted when present.

In examining the tongue we frequently detect a foulness in the breath. This is often due to sore-throat, bad teeth, decomposing particles of food or blood in the mouth or nose, ozæna, and gangrene of the lung: it may, however, arise also from disorder of the stomach due to grave febrile disorders, to prolonged constipation or intestinal obstruction, to errors in diet, to particular forms of dyspepsia with fetid eructations, or to the chronic and baneful influence of alcohol, opium, and chloral. Some medicines impart a disagreeable smell to the breath, and among these the garlic odor of bismuth may be mentioned as it is apt to be overlooked (due to the occasional presence of tellurium in certain parcels as an impurity). Various well known volatile drugs likewise affect the breath.

VOMITING.

Vomiting should be considered in respect of what appears to be its immediate cause: we inquire as to whether it is connected with anything taken into the system, as food, drink and medicine; or into the lungs by direct inhalation, or in connection with emanations of various kinds; or by absorption through the skin, or through cuts and abrasions: the possibility of poisoning, intentional or accidental, or in connection with the occupation and habitation of the patient, must not be forgotten. We inquire, further, whether the vomiting is associated with the position of the patient, induced, for example, on moving or on rising from bed; whether it only comes on at particular times, as in the morning, or in connection with coughing; whether it is associated with, or preceded by, sickness, nausea, or pain in the stomach and liver, or connected with jaundice, or with disorders of the bowels. Vomiting is likewise frequently associated with headache, pain in the back, fever, paralysis, convulsions, insensibility, dropsy, disease of the urinary organs, and disorders of the menstruation. We must inquire in certain cases whether there has been any exposure to the sun, any injury to the head or belly, any surgical operation, or any other obvious fact of this kind in the previous history of the patient.

When due to ingesta, the vomiting may be immediate, or it may not occur for a few hours: some assistance may be derived from the known tendency of the patient to vomit readily, or after certain articles: when in such cases the vomiting is not immediate, there is usually some period of sickness, of coldness, faintness, or giddiness just before the vomiting occurs, and there is often a history of some previous derangement of the *primæ viæ*, perhaps with furred tongue, constipation, &c. When sickness and vomiting are due to these last-named causes, there is usually great and permanent relief from the emptying of the stomach, but sometimes improper food and certain medicines (antimony, chloroform, opium, &c.) set up a more prolonged vomiting, due probably to some changes being induced by them in the digestive organs (gastritis, jaundice, intestinal catarrh, dysentery, &c.), as evidenced by the other symptoms of these complaints. Allied to this is the vomiting induced by the use of rich food in excess, or the morning sickness so common in those who drink alcohol regularly and freely, although perhaps never to the extent of causing obvious intoxication, or in those who are addicted to the frequent use of sedatives. The vomiting in such cases may be due to a practice long continued and not to any one act which we can name.

When the stomach has been upset from any cause, many things irritate it which would not otherwise do so: when even a little cold water is almost immediately rejected, we have evidence of very great irritability of the stomach.

The influence of the recumbent position in helping to ward off sickness and vomiting, applies to nearly every variety of the disorder; but in some cases the effect of change in position is very great; in uterine flexions and in pregnancy, the erect position often determines vomiting at once, and this is no doubt one of the reasons why the sickness is chiefly marked in the morning in many of these cases. In cases of vomiting due to abdominal abscesses, peritonitis, and general debility, the influence of position and the importance of perfect rest after swallowing anything are often very marked. The sickness caused by the rolling of a vessel at sea, by rapid rotation, &c., may be mentioned in this connection, although such sickness is probably caused in some way through changes in the cerebral circulation.

The pains and discomforts associated with vomiting are very variable. In fevers and inflammatory diseases the vomiting is usually accompanied with more or less headache, and often with pain in the back, and a feeling of soreness in the limbs, or with general malaise. But in addition to this there is often pain in the chest, over the liver or gall-bladder, the bowels, kidneys, bladder, ovaries, uterus, testicles, &c., according to the special organs attacked.

Pain in the stomach itself should be inquired into as to whether it appears immediately after a meal (as is common in gastric ulcer), or only after the process of digestion has actually been going on (dyspepsia); whether the pain is associated with much wind in the stomach, and whether it is relieved by eructations, or by the act of vomiting. This relief is often very marked in cases of dyspepsia and of dilation of the stomach. The sense of sickness or nausea usually precedes vomiting from most causes, but not unfrequently it is absent in the vomiting due to cerebral disease, and occasionally in that of renal disease, so that "causeless vomiting" should always be considered from this point of view. Apart from serious cerebral lesions, morning sickness is not uncommon in those whose brains are overtaxed to a serious extent. Vomiting without any very obvious cause is also found in Addison's disease, Pernicious anæmia, and other constitutional disorders. In cerebral disease violent headache often accompanies the vomiting, and headache is very often associated with the sickness and vomiting due to indigestion. The combination of headache and vomiting (both in extreme forms) is seen in the nervous affection known as "sick headache" (*migraine*), but in this case the headache is usually unilateral (*hemicrania*), and the duration of the attack limited to a few days at most. While pain in the back and vomiting are common in all febrile affections, such a pain with very marked tenderness in the spine may sometimes denote a spinal meningitis, or some other form of inflammatory mischief in the cord.

Disorder of the bowels frequently indicates the cause of the vomiting with which it is associated. Vomiting is often severe at the beginning of summer diarrhœa, especially in children, and it is common also in cholera and dysentery; it sometimes accompanies the act of defecation. It is likewise common in cases of prolonged constipation, whether from general disorder of the digestive organs, or from serious obstructions with the attendant inflammation, due to hernia, internal strangulation, invagination, &c. Examination of the hernial regions, of the state of the abdomen, of the character of the vomited matters, and of the stools, if any, should never be neglected. Severe vomiting and diarrhœa sometimes occur in the various forms of peritonitis. This combination is also found at the beginning of certain cases of malignant scarlatina and measles.

Irritation of the fauces, produced by choking, or by an infant's sucking too greedily, or perhaps by an elongated uvula, or by coughing, very often produces vomiting. Various forms of cough, especially when associated with profuse expectoration, are apt to excite vomiting. The paroxysms of whooping-cough are often terminated by an act of vomiting. It may be noticed in passing that severe vomiting and retching may set up a form of coughing and hawking which may seem again to induce further vomiting.

Menstrual irregularities, uterine flexions, pelvic inflammations, and other forms of uterine and ovarian disease, are frequently responsible for severe and persistent vomiting with great sickness. Any history of suppression of the menses, within the child-bearing period of life, associated with this symptom, should lead us to consider the question of pregnancy.

In the vomiting due to renal disease we usually have important assistance from the state of the urine; vomiting occurs at times in all forms of kidney affections, but the passage of renal calculi, and the poisoned state of the system known as uræmia, may be named as conditions specially likely to give rise to vomiting. The occurrence of vomiting in connection with a great diminution of the urine in renal disease is always of very serious import in this respect. The vomiting and other alarming symptoms observed in retrocedent gout may likewise be mentioned here.

Vomiting is a habitual accompaniment of the paroxysmal and excruciating pains in the hepatic region due to the passage of gall-stones; it usually precedes the jaundice due to this cause. A certain amount of vomiting, indeed, is a common precursor of jaundice from whatever cause, although it is occasionally quite absent. (See Jaundice, p. 332.)

The quantity of matter ejected, and the sensation of sourness, burning, bitterness, fetor, &c., experienced during the act are of importance in judging of the size of the stomach and of the changes which the contents of the stomach have been undergoing. (See Vomited Matters, below.)

ŒSOPHAGEAL VOMITING differs from ordinary gastric vomiting in the relatively small quantity which comes up, and in the absence of effort and straining during the act. It bears some resemblance to the sudden emptying of an india-rubber tube on removing it from a large water tap. It occurs in cases of stricture of the œsophagus, especially when there is dilatation of its cardiac extremity. This is almost always a malignant disease, but it may also arise from injuries (burns and caustic liquors).

VOMITED MATTERS.—These should always be preserved for inspection, especially in cases of suspected poisoning, and when the vomiting is of an obscure character.

The quantity vomited at a time is often important, as it helps to reveal the size of the stomach, and to indicate the extent to which the meals, of several days it may be, are retained. Excessively large quantities are ejected in cases of dilatation of the stomach (due to cancer of the pylorus, or other causes). These excessive quantities are often only ejected at intervals of two or three days, and the disproportion between the amount swallowed on a given day and the amount vomited, serves to indicate the retention of several days' food. The relatively large quantity vomited in certain cases after the swallowing of a small amount of bland fluid, serves usually to reveal somewhat serious congestion, if not erosion or ulceration, of the stomach. The "coffee ground" vomiting in such cases is due probably to the exudation of blood, whose character has become altered by the juices of the stomach. (See black vomited matter, p. 313.)

The obvious character of the vomited matters often explains an attack of vomiting, as when we find unripe fruit, undigested pie-crust, and similar articles brought up by a sick child, or when we find alcoholic liquors vomited by a drunken man. The curdled milk vomited by infants does not necessarily imply an undue acidity of the stomach, but the excessive tenacity or solidity of the curd may indicate that the particular milk given cannot be digested.

The degree of digestion undergone by the ejected matters may be important, as indicating the length of time the food has been retained. Occasionally a recent meal is retained while former meals which have been so far digested are ejected, owing probably to their being more fluid. The character of the matter vomited, as experienced by the patient, especially as to sourness, bitterness, fetor, &c., is sometimes of value; the smell and reaction can be ascertained by ourselves. The conjunction of great acidity in the vomited matters with alkalinity of the urine has often been noticed.

The smell is valuable as assisting our recognition of the nature of the matters vomited. It is further of great importance when the odor can be recognized as distinctly fecal. Occasionally various forms of decomposition simulate this odor, but when it is quite unequivocal it indicates some form of obstruction or strangulation of the bowel, or some fistulous communication of a lower part with a higher part of the intestine, or with the stomach itself. The yeasty or frothy appearance of the vomited matters indicates that fermentation has been going on in the contents of the stomach. This is often associated with the odor peculiar to this process, so that the smell of the vomited matter and of the patient's breath resembles that of a barrel of beer or porter. Torulæ and sarcinæ should be searched for in such cases. (See Microscopic Examination, p. 313.)

Blood in large quantity can be generally recognized as such. It is usually darker in color and less frothy than that brought up from the lungs. Large hemorrhages from the stomach are commoner in simple gastric ulcer than in cancer or any other affection of this organ. Occasionally large quantities of blood are vomited from the opening of an aneurism into the œsophagus, but such an accident is usually rapidly fatal. Blood in small quantities, causing florid streaks amongst the mucus and vomited matters, is not uncommon in any very violent attacks of vomiting if long continued. Such streaks are specially apt to appear in cases associated with congestion of the stomach from disease of the liver or other causes. Dark fluids, resembling "*coffee grounds*" or "*sooty fluids*," are almost always composed of altered blood, acted on by the digestive juices. They are found frequently in cases of cancer of the stomach, in gastric ulcer, in congestion of the stomach, and in peritonitis; their occurrence towards the end of a prolonged labor may likewise be mentioned here.

Bile in the vomited matters is often complained of when the presence of the altered blood just referred to is really meant. Bile is to be recognized as a greenish or yellowish viscid fluid; it may be vomited up in any case where the retching and straining are prolonged, after the stomach has been emptied of its contents.

Pus is rarely vomited from the stomach, although very frequently brought up from the lungs. Occasionally submucous suppuration of the stomach, stricture of the œsophagus, or of the cardiac orifice of the stomach, and the opening of an abscess into the stomach, may give rise to this symptom.

The appearance of worms and of shreds of hydatids is important: the round worm (ascaris lumbricoides) is the only one met with commonly in such a way. It is occasionally vomited by children during illnesses of various kinds, not directly related to the presence of worms.

THE MICROSCOPIC EXAMINATION OF THE VOMITED MATTERS reveals muscular fibres, starch granules, oil globules, and shreds of vegetable tissue, according to the diet of the patient. Crystals of margarine, &c., are also often seen. Blood, pus, &c., may be recognized, if their structure be not destroyed by the digestive fluids. "Cancer cells" can seldom or ever be recognized as such with any degre of certainty. The growth known as *Torula cereve-*

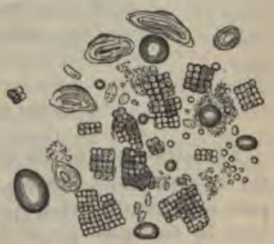

Fig. 31.—*Sarcinæ Ventriculi*, with starch granules, and oil globules, from vomited matters. (Otto Funke.)

siæ, or the yeast plant, is often found in fermenting matter from the stomach (see Fig. 55, Chap. xiii.). *Sarcinæ* should likewise be searched for when there is fermentation, or in cases of accumulation of the contents of the stomach. (See Fig. 31.) They are found in many cases of dilatation of this organ, from whatever cause, in ulcer and cancer of the stomach, without dilatation, and in certain cases of gastric catarrh. Their presence or absence cannot be relied on in the differential diagnosis of these affections. These are little square structures resembling wool-packs, from which they take their name. When found in the stomach or its contents they are called *Carcinæ ventriculi*, but similar structures have been found in the urine (see Chap. xiii.), and in various other fluids of the body. Digestion of the vomited matter in liquor potassæ brings out the appearance of the sarcinæ somewhat more distinctly.

For the appearance of Hooklets, &c., from Hydatids, see Fig. 42. Casts of the gastric follicles have been described by Dr. Fenwick as occurring in vomited matters.

Eructations and Regurgitation of food or fluids are to be considered as to the time at which they occur with regard to meals. A certain amount of regurgitation of milk, after sucking, is quite natural in infants. In adults, regurgitation may occur during the process of digestion; in such cases it is usually accompanied with pain and excessive acidity. (Pyrosis.) There may be such an appearance of fluid in the mouth, however, without acidity; indeed the fluid which thus ascends from the stomach may be quite bland or even alkaline; such "waterbrash" is always an indication of digestive disorder, and occasionally of serious lesions of the stomach. Apart from the ascent of actual fluid from the stomach, the patient may be conscious of excessive acidity, and the gas belched up may be recognized as very sour.

FLATULENCE AND HICCUP.

Flatulence manifests itself by distension in the region of the stomach and bowels, causing often a certain amount of pain and discomfort in these situations, relieved to some extent by the passage of wind from the mouth or from the anus. Rumbling noises and colicky pains often attend the passage of wind along the intestinal tract. But in addition to these more obvious symptoms, wind in the stomach often gives rise to pain between the shoulders, or about the heart, to giddiness, faintness for a minute or two, to palpitations of the heart, &c.

The period in the process of digestion at which the flatulence begins to appear should be ascertained, as also the influence which certain articles of diet have in determining the flatulence. (Vegetables, saccharine, starchy, and fatty foods, tea, tobacco, alcohol, &c.) The peculiar fermentation which leads to the production of gas may be often guessed at by the description which the patient gives of the taste and smell of the eructations, or perhaps it may be judged of by the observer. The lactic acid, the butyric acid, and the alcoholic fermentations are the commonest.

The repeated passage of wind from the bowel in cases of intestinal obstruction serves to show that the obstruction is not absolute. The suppression of the passage of wind leads in such cases to excessive tympanitic distension of the abdomen, if the seat of obstruction be low down.

In addition to intestinal obstruction, the accumulation of wind in the bowels is commonly observed in peritonitis, both acute and chronic (puerperal, traumatic, and tubercular, as well as other forms). In enteric fever, a certain degree of tympanites is habitual, and in various adynamic states it often assumes alarming characters. In diseases of the liver, and in ascites resulting therefrom, such flatulent distension is often most distressing. In rickets, and in some forms of infantile disease characterized by digestive derangement, distension of the bowel is so habitual as to lead to a permanent enlargement of the belly, sometimes simulating more serious disease. Flatulence in the stomach and bowels is one of the commonest features in cases of hysteria. The sensation compared to the ascent of a ball of wind to the throat, producing a sense of impending suffocation, is often described by hysterical patients (globus hystericus).

Hiccup is common as appearing readily in certain persons after eating or drinking; when of short duration it is seldom of much importance. Protracted duration of hiccup is always a serious symptom, especially in fevers or other illnesses with much nervous prostration, in diseases of the liver, and in cases of intestinal obstruction.

STATE OF THE BOWELS—ABDOMINAL PAIN.

THE STATE OF THE BOWELS has to be noted in most cases. In healthy subjects the bowels act about once in the twenty-four hours: certain persons have two motions in the day, or a motion only once in the two days, without any real departure from health. In children the motions are, as a rule, more frequent than in adults, and in young infants three or four motions in the 24 hours may be regarded as normal. In judging of the *frequency or infrequency of the motions*, as an index of disease, we must have regard to the quantity and quality of the food used, and the amount of muscular exercise. Scanty food, or the use of food that can be nearly all absorbed without residue, and the absence of active exercise, tend to produce scanty and infrequent motions. Constipation, prolonged beyond 3 or 4 days, must be regarded as an abnormal state: occasionally, however, there is an interval of nearly a week between the motions in persons who reckon this their natural condition. The frequency of the motions should be stated, if possible, as to the actual number of stools in the 24 hours: occasionally, it is important to know whether the frequency is less during night, and then the number of stools by day and night may be given separately. The influence of certain meals may often be seen in determining several motions at particular times, although there may be no disturbance afterwards. In children this is often so marked as to give rise to the erroneous idea of the milk just swallowed having passed at once through the bowels. The influence of movement and exertion, likewise, may sometimes be traced in the same way; the relative frequency of the stools at particular times, and under particular circumstances, has often to be specially noted, in order to give us a true idea of the state of the case.

The consistency of the motions is the next point of importance, but this falls rather to the section on the character of the stools (p. 319).

The degree of force or straining during defecation, the presence of pain in the bowels (see next section), the force with which the motions are expelled, the passage of wind with the motions, and the presence of faintness or sickness before, during, or after defecation, are all points which should be inquired into, particularly in cases of diarrhœa and constipation, and of partial obstruction of the bowel.

When motions are passed in bed and without notice, it should be ascertained whether this arises from unconsciousness, from defective sensibility in the parts, from paralysis of the sphincters, from great fluidity of the motions, from spasmodic or irregular action of the bowel, from inability of the patient arising from pain or paralysis to effect the necessary movements, from idiocy or defective intelligence, from indifference, or, in children, from want of training. The intentional or wilful soiling of the bed, so as to mislead or to secure attention, should also be remembered as an occasional occurrence.

PAIN IN THE ABDOMEN AND BOWELS.—Pain in the region of the bowels is of such importance that we must try to discriminate the different forms, and, as we cannot say at once whether the pain is in the bowels themselves, or in adjacent organs, we must consider them together.

Tenderness of the abdomen may be general or local, and all degrees of tenderness are met with. Generalized tenderness is found in peritonitis, sometimes to an extreme degree, so that the least touch, or even the pressure of the bedclothes is painful; the most extensive peritonitis, however, may exist with but little tenderness; and in certain puerperal cases, and in the chronic forms of peritonitis the tenderness is often extremely slight, or even altogether absent. Apart from wounds and other injuries, surgical operations, and childbirth, we find acute peritonitis to arise most frequently, perhaps, from perforation of the stomach and bowels, in the course of gastric and intestinal ulcers, enteric fever, and affections of the cæcum and vermiform appendix. Abscesses and accumulations of various kinds may, by rupture, produce the same effect (hepatic and renal abscess, hydatids, ovarian cysts, vertebral abscess, rupture of gall-bladder, ulceration of gall-duct). Tubercular deposits, although commoner in chronic peritonitis, sometimes set up an *acute* attack. The previous history, the mode of onset, and the other concurrent symptoms must here guide the diagnosis.

Sometimes, however, peritonitis arises without any obvious cause (so-called idiopathic). Certain cases of rheumatism affecting the abdominal walls are not easily separable from peritonitis, as tenderness, fever, and vomiting may all be present. In many cases of hysteria there is extreme sensitiveness and shrinking on touching the abdomen: the absence of pyrexia in such cases usually serves to negative the idea of acute inflammation.

Localized tenderness, from circumscribed peritonitis, is found particularly over the cæcum (*perityphilitis*), and in the neighborhood of the uterus (*perimetritis, pelvi-peritonitis,* &c.) Occasionally a localized peritonitis, particularly over the liver, is found associated with Bright's disease, syphilis, and other depraved states; and a localized peritonitis is said to be sometimes produced by embolic lesions in the spleen.

Localized tenderness, however, may likewise be due to various affections of the abdominal organs themselves apart from peritonitis: we aim at determining the site of the tenderness in relation to the organs, and at discovering any alterations in the size, position, shape, or density of the viscera in question. (Congestion and cancer of the liver, cancer or ulceration of the stomach, dilatation of the gall-bladder, calculous affections of the liver and kidneys, inflammations, dilatations and displacements of the kidneys, disease of the supra-renal capsules, inflammations of the ovaries, uterus, or bladder, and aortic or other forms of abdominal aneurisms, may be mentioned in this connection.)

Colic—spasmodic and painful contraction of the bowel—often produces pain quite as great as that of peritonitis: the parts, however, are seldom very tender, indeed, pressure may relieve the pain: the temperature, moreover, is usually natural. In severe persistent colic, associated with constipation, the question of lead poisoning should be considered. In an attack of abdominal pain, with constipation and vomiting, even when no local tenderness or tumor is complained of, the hernial regions should be carefully examined, at least, in patients of whose history we are ignorant, and the question of internal strangulation, invagination, &c., must be considered before resorting to energetic cathartics.

Abdominal pains, apart from any evidence of peritonitis, intestinal obstruction, or inflammations of the viscera, sometimes occur in such a form as to lead to the diagnosis of abdominal neuralgia, but this must always be accepted with the greatest reserve. Affections of the mesenteric glands (tubercular and malignant) are often associated with severe pain of obscure origin, and old adhesions of the intestines may give rise to pain appearing at particular times in connection probably with the varying position of the bowel, without any recent inflammation. Neuralgic pains referred to the region of the groin are often due to uterine disorders. In chronic peritonitis the pain varies much in severity; there may be extensive disease of this kind without any remarkable pain or tenderness having ever been noticed by the patient; variations in the severity of the pains in such cases depend probably, in part, on the dragging of adhesions, as just described, occurring particularly in connection with vomiting, with the action of the bowels, distension of the intestines, &c.; fresh attacks of acute inflammation, supervening in chronic peritonitis, may sometimes be recognized by the pains being associated with a special local tenderness, and with an elevation of the general temperature.

Abscesses and tumors, especially aneurisms of the aorta, and malignant disease of the abdominal organs, or of the bones, often cause severe abdominal pains during the early stages at which their existence cannot be recognized by the most careful physical examination.

Pains associated with defecation are of various kinds. When there is only slight pain just before the bowels act, passing away soon after the motion, it is of but little consequence; it is very common, especially in all forms of looseness of the bowels, and in connection with the action of purgatives. When the pains are more severe, of a griping character, and frequently recurring, considerable importance is to be attached to them. Looseness of the bowels with such pains often proceeds from the irritation set up by improper or undigested food, fruit, &c.; in dysenteric diarrhœa and dysentery, the pains accompanying defecation are usually of a more straining character, and the sense of the bowel not being properly relieved is usually very marked (*tenesmus*).

Painful defecation, with constipation, is commonly due to the size or hardness of the fecal masses being such as to give rise to pain from this alone; the masses are sometimes so hard or so large, and the rectum so much paralyzed, that even painful forcing fails to dislodge the feces, and they have to be softened by enemata, or even scooped out mechanically. With hard masses of this description any tender parts of the rectum and anus are apt to be rendered exquisitely painful; inflamed piles, and fissure of the anus, prolapse of the rectum, and various forms of inflammation, ulceration, or excoriation of the parts may be mentioned as common causes of exquisitely painful defecation: a careful examination of the parts is often necessary to avoid serious mistakes.

Appearance of Motions.—The motions should be examined as to several points; the most important of these will now be considered.

Consistency: we ascertain whether the motions are "formed," that is, possess the cylindrical shape of the bowel; the diameter of the pieces of fecal matter is of importance in stricture of the bowel, as in certain cases they are found to be very narrow, or perhaps flattened and riband-like. Somewhat globular masses of various sizes, usually hard and dry (*scybala*), are often found in cases of constipation; such pieces have lost much of the moisture and air naturally contained in feces from their being long retained in the pouches of the large bowel. Feces long retained often fail to float in water, on account of this loss of air. If the motion be not "formed," it should be described as to whether it has the consistence of a thick or a thin pultaceous mass, or whether it is chiefly fluid, with a few solid masses interspersed. Fluid motions are often described as resembling "pea soup" (enteric fever); "rice water" (cholera); or the "scrapings of meat" (dysentery), &c.

The color of the motions is sometimes described simply by the terms dark, light, green, black, &c. Occasionally it is indicated by reference to the cause of the color: thus we speak of much bile or little bile being present. The natural color of the motions is derived from the biliary coloring matter; "clay-like" motions are found when there is an absence or a diminution of bile. *Melæna: black motions, from altered blood,* are found when blood is mixed with the motions in such proportions and at such parts of the digestive tract as to be acted on by the gastric and intestinal secretions (gastric and duodenal ulceration, intestinal hemorrhage from portal obstruction). When the hemorrhage is large, from whatever cause this may arise, the blood preserves much more of its usual color. When the bleeding is from piles, fistula, polypus, and cancer of the rectum, or from other lesions of the lower bowel, the blood in the motions usually retains its typical appearance as blood, with more or less of a florid color. *Black motions* are not at once to be presumed to derive their color from altered blood, as various medicines render their motions dark, particularly iron, bismuth, and charcoal, and, to a less extent, lead, copper, tannic acid, logwood, and some others; as logwood stains babies' napkins, attention is sometimes called to this peculiarity. Mercurials often render the motions darker, but this is partly owing, no doubt, to their being thus rendered more bilious. Motions with what looks like unmixed and unaltered bile (a greenish, yellowish, glairy fluid) are occasionally seen. *Green motions* are very common in infantile diarrhœa: the green motions sometimes persist for a considerable time after the diarrhœa has been checked; motions passed with a yellow color sometimes change their appearance, so that the napkins may be green after the lapse of some time when produced by the nurse. Sometimes the motions are almost *white*, not unlike boiled bread and milk. In children the motions often present a curdy appearance and possess a sourish smell. and not unfrequently undigested masses of curdled milk are found mixed up with the fecculent matter.

Mucus is passed in large quantity in some cases of invagination of the bowel—large quantities of glairy, clear, gum-like material coming away with little or no fecal matter. Such mucus may be colored with a little blood, or associated with large quantities of it. Mucus, usually of a less transparent kind, is found more or less in cases of dysentery, and in such cases, a little bloody mucus may constitute the whole of a motion, voided with a feeling of great urgency, and passed with much pain and straining. Other forms of mucous discharge, consisting of more opaque yellowish flakes and shreds, are passed in cases of catarrh of the bowel, and considerable casts of parts of the intestinal tract are voided in certain cases of so-called "mucus disease."

Shreds of mucus are often spoken of by patients as "skins," and are sometimes confounded by them with portions of disintegrated worms.

Pus in the motions may proceed from various affections of the lower bowel just named in connection with bleeding from the same situation (see p. 320), and some admixture of pus is common in dysenteric motions and in the affection referred to as intestinal catarrh. Inflammation of the cæcum sometimes result in the discharge of pus from the bowels.

Various abscesses open into the bowel, and may thus give a coating to the feces, or furnish a considerable quantity of pus. Of these the most common are pelvic abscesses, connected with childbirth, or at least with affections of the womb; but abscesses arising from the kidney and other organs in the abdomen, and even psoas abscesses, occasionally burst into the bowel. Abscess of the prostate usually opens in this way. Sometimes a cancerous tumor breaking down presents something like a purulent deposit in the feces. Portions of bowel which have sloughed may also be voided with the motions, usually, however, in a gangrenous or disintegrated state. This occurs in certain cases of recovery from invagination of the bowel.

Worms are usually seen quite readily if the motions are examined at all, at least in the case of round worms (*ascaris lumbricoides*), and tape-worms (*tæniæ* of various kinds). Thread worms (*oxyurides*), however, require to be looked for more closely, as they are small. Their movements, when expelled alive, assist in their recognition. (See Figs. 32 and 33.) In the case of tape-worms, the narrow parts should be specially looked for and preserved for scrutiny, to see if the head of the parasite is included in the mass. The different kinds of *tænia* may be recognized by the appearance of the head, and by the microscopic examination of the proglottides with regard to the arrangement of the passages in the uterus, with the ova, &c. For this purpose one or two of the large segments are placed on a microscopic slide to dry (after immersion in strong spirit) so as to be rendered transparent. The *Tænia Solium* and the *Tænia Mediocanellata* are the only tape-worms common in this country. (See Figs. 34–38.) Round worms resemble earth-worms in general appearance, although paler in color. The female worm is usually about the length of the page of this book, and the male is considerably smaller (400 mm. and 250 mm. respectively as a maximum). When dry, however, they shrivel up to some extent.

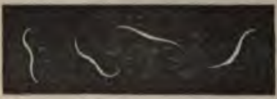

Fig. 32.—*Oxyurides Vermiculares*, Female, natural size. (After Davaine.)

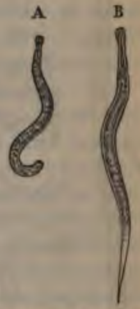

Fig. 33.—*Oxyurides Vermiculares*, magnified five times. A, Male; B, Female. (Leuckart.)

Portions of hydatids are sometimes expelled with the motions. Anything resembling these should be preserved for further examination. (See Fig. 42.)

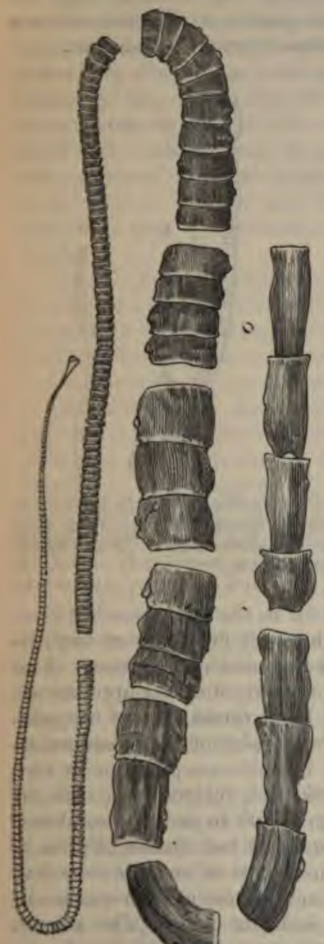

Fig. 34.—*Tænia Mediocanellata*, natural size, showing the different size and shape of the segments in the various parts. (The Tænia solium resembles this in general appearance: for distinction see Figs. 35–38.) (Leuckart.)

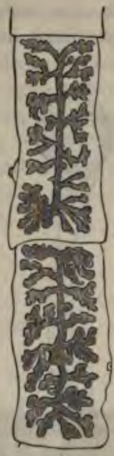

Fig. 35.—Proglottides of the *Tænia Solium*, magnified twice, showing arrangement of uterus. (Leuckart.)

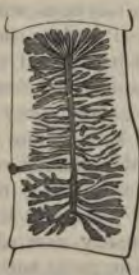

Fig. 36.—Proglottis of *Tænia Mediocanellata*, magnified, showing the arrangement of the uterus. (Leuckart.)

Fatty matter is occasionally found in the motions in large quantity, and has been noticed in certain cases of disease of the pancreas. Smaller quantities of oily material may be passed from the inability of the patient to digest or absorb the fat in the food, or the oil administered as medicine.

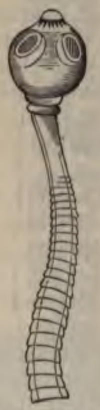

Fig. 37.—Head of *Tænia Solium*, armed with a circle of hooklets, showing two of the four suckers. (Dr. Cobbold.)

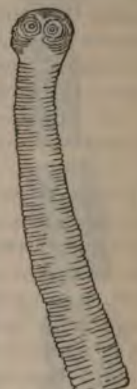

Fig. 38.—Head of *Tænia Mediocanellata* (not armed with hooklets), showing two of the four suckers. (Drawn by Dr. John Wilson.)

Gall-stones must be searched for in the way described elsewhere (see Jaundice, p. 337) when the discovery of them is important. We must accept the statement of patients as to passing gall-stones with great reserve, unless they can be produced, or unless they have been found in the way described, as hardened feces and intestinal concretions are sometimes mistaken for them.

Bones, *Coins*, *Artificial Teeth*, and various other things, swallowed by accident, are often found in the motions after very variable periods, extending sometimes to several months after the accident. Such articles are often more or less corroded by the digestive fluids, and the animal parts are usually greatly diminished in bulk, or even quite absent. The metallic parts acted on may have caused discoloration of the motions during the period the article was retained.

The Smell of the Stools is sometimes particularly offensive, and special odors can sometimes be recognized as peculiar to certain conditions, but they are not easily described. Amongst the most offensive are dysenteric motions, and the motions in certain forms and stages of enteric fever. In the diarrhœa of children the milk sometimes undergoes a peculiarly offensive decomposition, controlled in certain cases by the previous boiling of the milk. In jaundice also the motions are often very disgusting. Sourness can often be recognized as characterizing the motions of children, and such motions are often distinctly curdy. The odor of sulphuretted hydrogen, present in natural feces to a variable extent according to the nature of the food, is extremely marked during the internal use of sulphur and some of its compounds. Other medicines may also communicate their special odor to the stools.

THE CLINICAL SIGNIFICANCE OF CONSTIPATION AND DIARRHŒA varies extremely. Slight indications have been inserted in enumerating the different symptoms, and the following hints are now added.

Constipation is extremely common, in its slighter forms, in connection with disorders of digestion, especially such as proceed from nervous causes, worry of business, irregularity in habits, &c. But similar causes lead in certain subjects to diarrhœa. Alternations of constipation and diarrhœa are common in certain forms of gastro-intestinal disorder, and are met with even in dysentery and enteric fever. Occasionally also the constipation usual in cancerous obstruction of the rectum is varied by a profuse diarrhœa.

A constipated state of the bowels is habitual at the beginning of many febrile disorders. Pretty obstinate constipation is so frequent at the beginning of meningitis as to afford an important indication of its onset. Occasionally a pre-existing diarrhœa is replaced by constipation on the supervention of meningitis. Constipation when protracted, especially when associated with vomiting or hiccup, and abdominal pain, and swelling, should always dictate the necessity of examining for hernial strangulation, even in the less usual situations, or for considering the question of internal obstruction in its various forms, or of invagination of the bowel. Chronic peritonitis sometimes leads to similar symptoms. Paralysis (paraplegia) occasionally gives rise to constipation of such an obstinate character as to suggest the idea of obstruction.

Diarrhœa attends certain febrile states, apart from any specific intestinal affection, being induced in some way by the pyrexial state, or the depraved condition of the blood, and perhaps by the inability of the patient to digest the food taken in. Even in healthy states, undigested or indigestible food gives rise to looseness of the bowels. Poisonous substances often produce severe diarrhœa. In addition to the well-known cathartics and the irritant poisons, certain forms of shell-fish and the flesh of animals in certain states of decomposition may be mentioned. The influence of impure water, the leaking of sewage pipes, the emanations from foul drains, and the climatic and other influences which lead to dysentery may be mentioned in this connection. Cholera in its epidemic form, and in the less severe forms known as British or autumnal cholera, and Cholera Infantum, may likewise be referred to in this class. The scarlatinal poison sometimes manifests its early presence by a violent diarrhœa, especially in malignant cases. Possibly also the spontaneous looseness seen in certain stages of uræmia and in puerperal fever may be referred to a similar cause. Enteric fever with (its intestinal lesion) presents an intermediate form between the foregoing and those cases of diarrhœa which owe their origin to tubercular, catarrhal, or dysenteric ulceration of the bowels. Peritonitis frequently gives rise to severe forms of diarrhœa.

The presence or absence of the various concomitant symptoms, and the results of the physical exploration of the abdomen must be relied on for the differentiation of these forms.

THE TEETH AND GUMS.

An examination of the TEETH affords evidence in many cases of certain constitutional states, as well as of various local sources of disturbance. The number of teeth differs in the first and the second dentition. The age of young persons can sometimes be estimated from the state of the dental development.

FORMULA OF THE MILK TEETH.

$$\left.\frac{M_2 \quad C_1 \quad I_4 \quad C_1 \quad M_2}{M_2 \quad C_1 \quad I_4 \quad C_1 \quad M_2}\right\} \text{20 in all.}$$

The order of their appearance varies somewhat. As a rule the lower central incisors appear first, then the upper central incisors, and then the lower lateral incisors. The following may be given as the usual order and date of their appearance :—

Central incisors,	about the	7th	month.
Lateral incisors,	"	9th	"
First molars,	"	15th	"
Canines,	"	18th	"
Second molars,	"	24th	"

The order, however, is sometimes different; the date of the appearance is sometimes earlier, and often much later than appears above. The process goes on by little starts, with distinct intervals or pauses between.

Disorders of dentition.—Lateness in dentition often arises from the constitutional derangement known as rickets; the disturbances of digestion, and of the general health, arising from this cause, are often ascribed erroneously to the ills of teething. But although the first teeth have appeared at the usual time the rickety state may really exist, and from this cause, or from the occurrence of more definite attacks of illness, the normal progress of the dentition may be arrested or delayed for a time. Precocious cutting of the early teeth is often followed by delays in the subsequent ones.

During the process of teething the infant has usually a great increase in the amount of the saliva. Various disturbances of the health, especially diarrhœa, cutaneous eruptions, and convulsions, are ascribed by the public to this process, particularly when the dentition is delayed or irregular in its course; but these illnesses are sometimes due to disorders produced by the use of artificial food, which is very often begun about this time; or they may be due to rickets or to some other vice in the constitution of the infant. The advance of the teeth is characterized at times by great tenderness over the gums; in other cases the rubbing or squeezing of the gums seems to afford relief or satisfaction. The prominence of the gum over an advancing tooth sometimes give a fallacious idea of its nearness to the surface. Such appearances may come and go more than once before the tooth comes through. We can seldom safely predict the speedy cutting of a tooth unless the sharp edge be felt under the gum. Any unusual heat of the mouth, any increase in the salivation, and any little ulcerations of the gums should be noticed in connection with the teething process.

In rickety and syphilitic children the milk teeth often rot away or drop out prematurely. The same also happens occasionally in others, probably from gastric disorders.

THE SECOND DENTITION begins with the appearance of the *first permanent molars*, and this precedes the shedding of the twenty milk teeth, which begin then to fall out in succession.

FORMULA OF THE PERMANENT TEETH.

$$\left.\frac{M_3\quad B_2\quad C_1\quad I_4\quad C_1\quad B_2\quad M_3}{M_3\quad B_2\quad C_1\quad I_4\quad C_1\quad B_2\quad M_3}\right\}\text{ 32 in all.}$$

The order in which they make their appearance may be thus stated :—

Anterior molars,	at the	7th year.
Central incisors,	"	8th "
Lateral incisors,	"	9th "
Anterior bicuspids,	"	10th "
Posterior bicuspids,	"	11th "
Canines,	"	12th "
Second molars,	"	12th to 14th year.
Third molars,	"	18th to 25th "

The eruption of the permanent teeth seldom gives rise to much local or constitutional disturbance, except in the case of the "wisdom teeth;" considerable pain and swelling sometimes appear in connection with the cutting of those of the lower jaw in particular.

The shape and appearance of the teeth sometimes afford important indications. Transverse grooves and slight pitting on their surface are supposed by some to indicate a scrofulous constitution, or at least the presence of previous derangements in the health.

The notched teeth described by Hutchinson afford important evidence of congenital syphilis. They often coincide with syphilitic keratitis, and sometimes with nervous deafness and other forms of the inherited disease. The deformity affects the upper central incisors most frequently and most distinctly, although the other incisors and the canines may also be affected. The upper central incisors, in a typical case, are dwarfed both in their length and breadth; the atrophy affects the middle lobe, giving rise to a central notch at its edge; sometimes from this notch there may be traced a shallow groove both before and behind. These changes are not always present in hereditary syphilis; they are only of value as signs in the case of the *permanent teeth.* After a time the depth of the notch may be lessened through the wearing down of the edge, but

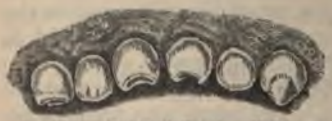
Fig. 39.—Notched Teeth—Malformation of permanent teeth found in hereditary syphilis. (Mr. Jonathan Hutchinson.)

the deformity can usually be detected even then. (See Fig. 39).

Caries of the teeth occurs from causes not fully known, but the lingering of acescent fluids about the teeth, arising from the decomposition of particles of food in the mouth, seems to favor this destruction. Caries is frequent in cases of chronic dyspepsia. This affection of the teeth sometimes accounts for the fetor of the breath which may be noticed; this might be erroneously ascribed to something else. The condition of the teeth, likewise, has important bearings on the diagnosis of facial neuralgia, pains in the ears, affections of the eyes, &c.; the pain sometimes radiates from the teeth, not only all over the face, but even down to the neck. For a proper examination of the teeth in this respect the assistance of the dentist is often very desirable, but in the absence of this we may learn something from detecting some special tooth, obviously rotten, or with an exposed pulp, which gives rise to sharp pain on pressing it or probing it. In a diffused facial neuralgia, from any cause, the teeth also may participate in the general suffering, so that we must search for a local and specialized tenderness of one or two teeth in particular. Neuralgia seems sometimes to be set up by the extraction of a tooth—the pain being recognized by the patient as different from that of the previous caries.

The rottenness or the absence of the teeth may throw important light on dyspeptic disorders, or even on the imperfect nutrition of a patient. Defects in the teeth may prevent the due trituration of the food necessary for its proper digestion.

Falling out of the teeth occurs in connection with mercurial salivation, and also in connection with scurvy. The earliest signs of these appear, however, in the gums. The teeth also fall out in certain cases of destructive ulceration involving the gums (noma). The milk teeth often rot and fall out prematurely in rickets and syphilis.

Grinding the teeth is almost habitual in certain children, and it readily occurs in others when the stomach and digestion are out of order. Its presence, therefore, is not to be ascribed at once to the irritation of worms, although this is a prevalent popular opinion. No doubt, however, it is frequently present in such cases. In smallpox and some other febrile diseases in childhood grinding of the teeth is an unfavorable indication. Although commonest in childhood this symptom is not unknown in adults.

THE GUMS are often spongy and their edges ragged and irregular in those whose teeth are bad and neglected, and when the tartar is very abundant. When these causes of irritation exist the indications from the gums are not so valuable.

Swelling of the gums, with slight tenderness, constitutes one of the earliest indications of the action of mercury. The special fetor of the breath due to mercury and the occurrence of salivation usually appear also. This influence is produced whatever may be the way in which the metal enters the system. Some other metallic poisons cause something of the same kind, but in a much less degree.

The blue or blackish line on the gums, just above the teeth, affords, when it is pronounced, a valuable indication of lead poisoning. When it is present we must inquire for the history of colic, and ascertain if any exposure to the deleterious influence of lead has arisen in connection with the water-supply or the occupation of the patient.

A red line on the gums is regarded by some as an indication of a phthisical constitution: although often present, no great reliance can be placed on its indications.

Very spongy gums, with submucous hemorrhages, are common in scurvy; bleeding readily arises from slight irritation of the parts; and fetor of the breath is also usually present. Slight forms of scurvy are not uncommon among laborers who carry their food to their work, and live on tea, bread and bacon, &c. Subcutaneous hemorrhages, &c., must be looked for. Purpura likewise affects the gums in a way somewhat similar to scurvy, and hemorrhages sometimes arise from them: these may prove serious from their persistence and the difficulty of stopping the bleeding.

Inflammation of the gums may form part of a general affection of the mouth, already described (vesicular, ulcerative, and gangrenous stomatitis; see p. 307). The local inflammation and swelling known as "gum-boil" arises from inflammation around the root of the tooth affected (Periodontitis): the tooth is often felt to be tender, and sometimes to be elevated, as it were, from the socket. The local disturbance, as manifested by swelling, and the general reaction are often extreme: when by accident the swelling is not considerable the first indication of the cause of the violent symptoms may be the appearance of pus by the side of the tooth. With inflammation of the gum from any cause more or less salivation is frequent.

The presence of sordes on the gums and teeth, of the white patches of muguet, and the discoloration of Addison's disease, have been noticed elsewhere (see pp. 305 and 317). Pallor of the gums affords a valuable indication of anæmia.

CHAPTER XII.

JAUNDICE AND DROPSY.[1]

It is convenient to consider these affections together, as they are frequently due to disease of the liver, and it is not uncommon to find them both in the same patient. But it must be remembered that dropsy is frequently due to other diseases which have no connection with jaundice or with any form of hepatic disease.

JAUNDICE.

When jaundice is well marked there can be no mistake about its presence. The yellowness of the skin and ocular conjunctiva, and the discoloration of the urine with bile, present a striking and easily recognized group of symptoms. Discoloration of the skin, somewhat resembling jaundice, is found in certain cases of anæmia, in chlorosis, in Addison's disease, and in the chloasma associated with fibroid tumors and other disorders of the womb. Exposure to the sun and weather may produce in certain complexions a tinge resembling jaundice, and the serious disturbances of the general health induced by intermittent fevers, by the presence of malignant disease, and by syphilis, all resemble, at times, the cutaneous discoloration of jaundice. All these may usually be seen to differ from the jaundice tint on a critical examination; and in nearly all these affections the whiteness of the conjunctivæ, which often indeed shine out with a pearly brightness, removes the cases at once from this category. The conjunctiva, however, sometimes presents a dingy yellow color, apart from jaundice, this being due to the presence of yellow subconjunctival fat, and this complication presents a serious difficulty in determining the presence or absence of a slight discoloration; but when the color is due to this cause it is usually more localized to special parts, and not so evenly diffused as in jaundice.

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[1] The works of Murchison and Frerichs are of great value in the study of the affections dealt with in this chapter.

The subject must be considered also in connection with the section on the Physical Examination of the Abdomen, Chapter xvi., Part 3, and the works referred to there, including treatises on Ovarian Disease by Spencer Wells, &c.

The books referred to in Chapter xiii. on urinary and renal diseases must likewise be consulted; and works on diseases of children are of special importance in connection with infantile jaundice, tabes mesenterica, and certain forms of dropsy affecting the young.

The urine comes to our aid in such doubtful cases, for it very readily assumes the jaundiced color. The method of testing for bile pigment is described in the section on urinary examinations (see Chapter xiii.). No great reliance can be placed on the reports of patients regarding bile in the urine, as they often mistake bloody or concentrated urine for bilious discoloration, and the internal use of santoin or rhubarb may produce a certain resemblance to bilious urine. The urine shows the presence of jaundice earlier than anything else, but it likewise ceases the soonest to be affected, if the attack be passing off, so that the urine may be free although the conjunctivæ remain really tinged. By watching the skin, the conjunctivæ, and the urine, in different stages of the suspected jaundice, we are seldom left in much doubt. The urine in jaundice is often turbid from mucus: it seldom contains albumen, but usually deposits tube-casts.

The appearance of the stools renders much assistance in the study of jaundice, for while everything else is discolored, the motions are often free from bile, presenting a paler appearance than natural. This is often best described by the word "clayey." But we may also have marked jaundice with much bile in the feces. The pale color of the feces may thus in doubtful cases assist the diagnosis of jaundice, but their bilious color does not count for much as negativing jaundice. The motions in jaundice are usually costive, and if long retained in the bowel, the feces are often highly offensive, from decomposition going on within. The bile acts normally both as a purgative and an antiseptic.

OBSTRUCTIVE AND NON-OBSTRUCTIVE JAUNDICE.—The presence or absence of bile in the motions affords an important aid in classifying the cases according as they are, or are not, due to obstruction of the common bile-duct. If there be any such obstruction, the motions are pale in proportion to the depth of the jaundice; and we find that in cases due to obstruction the jaundice is much deeper than where no obstruction exists.

The obstruction may be due to something within the duct itself—thickened walls or excess of mucus give rise to the form called "catarrhal," or gall-stones may block up the channel, or the ducts themselves may be the seat of a cancerous growth. Ulcers, cicatrices, foreign bodies, and even worms have been known to interfere with the opening of the duct into the duodenum, and catarrh or inflammation of the duodenum may likewise do so. But the obstruction may be due to pressure from without, by a tumor (usually malignant) in the pancreas or duodenum; or by waxy or cancerous glands at the fissure of the liver; or, a tumor connected with the liver itself may, from its position, compress the duct, as in the case of a cancerous nodule, an abscess, an aneurism, or a hydatid cyst; or again an exudation of lymph (perihepatitis) may by its contraction constrict the duct. Abdominal tumors connected with the kidney, ovaries, &c., may compress the bile-duct and give rise to jaundice. The pregnant uterus, or fecal accumulations in the bowels may likewise do so; and hardened scybola have been mistaken for cancerous nodules in cases of jaundice due to such a cause.

In discriminating these causes we have regard to the size and form of the liver, the presence and character of the pain (if any), and the special symptoms of the various affections named, in their relation to the date of the appearance of the jaundice. In cancer the liver is usually enlarged, often nodular, more or less painful, and tender to the touch. The occurrence of jaundice is due to the accidental position, as it were, of the cancerous mass, and so it may be an early or a late symptom, and indeed is often absent in the hepatic cancer. Malignant disease elsewhere is, of course, a strong presumption in favor of the cancerous origin of jaundice. The persistence or variability of the jaundice is important; cancerous jaundice never disappears after it is established; the history of previous attacks of jaundice, therefore, which have passed off, predisposes one in favor of a less serious view of the case; but we must remember that in rare cases the previous attacks may have been of quite a different nature from the existing jaundice—thus gall-stones and cancer may exist in the same case. The concurrence of intense jaundice and pale stools with abdominal dropsy may be regarded as pointing to the obstruction of the duct and of the portal vein by the same cause, which in that case must be something outside of both, usually a cancerous mass. Slight jaundice may exist along with dropsy due to cirrhosis or to congestion of the liver; the jaundice in such cases is not only usually slight, but bile is not absent from the stools, unless, indeed, there be a complication from catarrh of the ducts giving rise to obstruction. Pain is an important symptom in the study of jaundice. Pain is usually, but not always, more or less present in cancer; even in catarrhal jaundice, with perhaps some congestion of the liver, there is some pain and discomfort in the hepatic region. In the passage of gall-stones the pain reaches a maximum; it is very violent, paroxysmal, and often associated with great sickness. Such paroxysms of pain may occur several times during the attack of jaundice, as well as for a day or two before it appears. Occasionally the jaundice is permanent, the gall-stone being permanently impacted in the common bile-duct; but attacks of pain and of jaundice from gall-stones are apt to be repeated after an interval of months or years. (It is possible to have an attack of biliary colic without jaundice, from the gall-stone escaping quickly, or from its only affecting the cystic duct.) The detection of gall-stones in the motions settles the diagnosis. In doubtful cases, where there is a suspicion of cancer, these must be carefully sought for. Although dried gall-stones float in water, they do not come to the surface on adding water to the feces and breaking up the solid masses. To detect them we must pass all the motions through some form of sieve, or through a muslin filter after pounding them sufficiently with a stick, and the offensiveness of the process may be lessened by adding previously some disinfectant, such as Burnett's or Condy's fluid. If there is any doubt as to the object found being a gall-stone, a portion of it may be pounded and dissolved in sulphuric ether or boiling alcohol, from which crystals of cholesterine are deposited. (See Fig. 43, p. 347.)

Rigors occurring in jaundice point to distension of the bile-ducts from the obstruction of gall-stones; or to the presence of abscess of the liver; or perhaps to the existence of pyæmia of which the jaundice may be a symptom. Hemorrhages from the stomach and bowels, and subcutaneous blotches occur in old and severe forms of jaundice, and are due probably to deterioration of the blood in cases of obstruction, or to blood-poisoning or portal obstruction, in those serious cases where there is no obstruction of the ducts in any form. Hemorrhages from the umbilicus occur in some serious forms of infantile jaundice (see p. 336). In addition to the symptoms already noticed, itchiness of the skin, yellow vision, cutaneous eruptions, slowness of pulse, a lowered temperature and impaired nutrition, are occasionally very noticeable. Sometimes jaundice appears without anything else to attract attention, not even squeamishness or impaired appetite. Popularly, jaundice is often ascribed to a feeling of disgust produced by disagreeable sights and smells, but probably the incipient jaundice really makes the person more squeamish than usual in such cases.

Cases of jaundice without obstruction of the ducts may be due to various poisonous agencies, animal, vegetable, and mineral, including under this name certain specific fevers (relapsing fever, typhus, pyæmia, phosphorus, copper, chloroform, ether, &c.). Acute atrophy of the liver, yellow fever, and epidemic jaundice may also perhaps be properly classified under this heading. Mental and nervous disturbances sometimes produce jaundice; active or passive congestion of the liver, deficient oxidation of the blood, chronic atrophy of the liver, and imperfect elimination of bile from protracted constipation, may all, likewise, give rise to non-obstructive jaundice. The enumeration of these causes may serve to direct our inquiry in studying cases of this variety of jaundice; these are often very puzzling, and when associated with cerebral symptoms very alarming. The test of detecting the biliary acids in the urine has been proposed as an assistance in the study of these cases, but hitherto without much success. (See Urine, Biliary Acids.)

In acute atrophy of the liver the jaundice is not very intense, but it is persistent; there are febrile and nervous symptoms; the hepatic dulness can usually be made out to be small, but the liver is not always reduced in bulk in this affection: crystals of tyrosine may sometimes be found in the urine after evaporation. This disease is specially apt to attack women and to be associated with the puerperal state.

In infancy we have often a spurious jaundice due to mere discoloration of the skin, for a few days after birth, without any affection of the conjunctivæ. A true jaundice occurs not unfrequently from catarrh of the ducts, and sometimes from imperfect oxidation of the blood, especially in the unfavorable surroundings of a badly ventilated lying-in hospital. A very serious form of jaundice occurs in infancy associated with an unhealthy state of the umbilicus (phlebitis, peritonitis, pyæmia), and occasionally with congenital defect of the bile-ducts: this malformation, although rare, has been known to occur in several members of the same family, and has been known to occur in several members of the same family, and has been supposed to be possibly due to intra-uterine syphilitic perihepatitis: this defect is sometimes associated with fatal hemorrhages from the umbilicus and other parts: the jaundice appears within a few days of birth and, even if otherwise uncomplicated, leads to atrophy and death within a few months.

DROPSY.

Dropsy must be studied in respect of its severity, its extent and localization, the mode of its onset, and the evidence, if any, of other coexisting diseases, especially of disease of the heart, liver, kidneys, spleen, and ovaries, or of other swellings or tumors in the abdomen or chest.

Anasarca and Œdema.—When *general dropsy* of the whole body (general anasarca) appears somewhat suddenly, the common cause is renal disease (nephritis). In such cases, if the attack be not too sudden, the swelling is usually first noticed in the face in the morning, the patient feeling his eyelids stiff and heavy, and his friends noticing a degree of puffiness in the cheeks and around the orbits; this often disappears after moving about for a time, the swelling appearing in the feet and ankles at night: this in its turn disappears with rest in the horizontal posture—the fluid gravitating according to the position of the patient. To detect œdema in the subcutaneous cellular tissue we press firmly and steadily with the point of the finger and observe if a "pitting" or depression remains. We select, in slight cases, some part with the resistant bone beneath to bring out this pitting more easily. In extreme dropsy the loose areolar tissue of the eyelids, penis, and scrotum become specially distended. The testing of the urine usually shows such a case to be one of renal origin; pain in the loins, vomiting, and more or less shivering are common in acute cases. Severe renal dropsy has been known to exist without albuminuria, but this is rare; the previous history of scarlet fever, &c., often assists the diagnosis.

Œdema of the feet, and even of the face, closely resembling renal dropsy, is found at times to be due to anæmia, the altered condition of the blood predisposing to these exudations. The urine should be carefully tested more than once in such cases before deciding on the absence of renal disease, as albumen is temporarily absent from the urine in certain cases, especially before breakfast. The history of fever, floodings, and other disorders of the menstruation, or to previous debilitating diseases, usually supplies an intelligible cause of this anæmia.

Œdema beginning at the feet, and gradually invading the legs, but keeping strictly to the lower limbs, or at least to the lower part of the body, is usually due to some mechanical impediment to the circulation either in the limbs, in the abdominal vessels, or in the heart itself. Varicose veins, thrombi, aneurisms, tumors, or anything, such as a bandage, pressing on the veins of the limb, tumors in the pelvis, abdominal tumors generally (including pregnancy), glandular enlargements (scrofulous or malignant) in the neighborhood of the vena cava, and similar obstructions, may all act in this way. Nearly all the forms of cardiac disease lead to some impediment to the circulation, so that, sooner or later, œdema of the feet is apt to appear (valvular disease, enlarged, weak, and fatty heart). When such dropsy works its way up to the abdomen, the increasing pressure on the renal veins is apt to set up congestion of the kidneys, and this complication may cause the dropsy to assume the character of general anasarca. Allied to this œdema from mechanical impediment or feeble circulation, is the swelling of the feet so often seen in old people, and in many exhausting diseases especially before death. Chronic renal disease, however, may also give rise to dropsy completely limited to the lower limbs.

Œdema of the upper part of the body may be but part of a general dropsy, specially appearing in the dependent parts of the trunk, or in either arm, according to the accident of position: careful observation and inquiry as to the posture of the patient immediately prior to our visit usually explain the variations in such cases. Œdema limited to the chest, arms, neck, or face, points to some mechanical obstruction to the circulation within the chest, giving rise probably to pressure on the veins. Tumors in the mediastinum, especially aneurisms, cancers, and glandular swellings (lymphadenoma), must be remembered in this connection; the discrimination of these must be sought for by physical signs and other symptoms.

A form of *œdema* in young children, *affecting chiefly the dorsum of the hands and feet*, but occasionally extending to the legs also, differs from that usually seen in adults in that it does not pit on pressure; the swelling is firm and the skin drawn tightly over it. This condition is met with in various wasting diseases, chiefly chronic diarrhœa, and in connection with carpopedal spasms; it always serves to indicate a serious derangement of the strength, but is not necessarily of fatal import; it is seldom or never associated with albuminuria, and seems to belong rather to a class of anæmic dropsies. Allied to this state is the condition described by Underwood as "Hide bound," and by the French writers as "*Sclérème*," or "Induration of the cellular tissue."

ABDOMINAL DROPSY is of three kinds: fluid in the cellular tissue of the abdominal walls; fluid within the peritoneal cavity; fluid within some cyst in the abdomen, usually of the ovary, but occasionally of the kidney, liver, or other parts.

Œdema of the abdominal parietes is sometimes so considerable as to suggest the presence of fluid in the peritoneum, with which indeed it may be associated. It may be due to the causes producing general dropsy, as already detailed, but when it seems unduly great in this region there is usually some local obstruction to the return of blood from the veins in this region. This œdema is discriminated from ascites by the test of "pitting," and in applying the pressure we avail ourselves of the tissues over the ribs, or over the ilium and sacrum, when the parietes in front yield too much so as to make the demonstration difficult. This œdema changes somewhat with position, but not immediately, as in the case of free fluid in the peritoneum, only after the lapse of some time.

Fluid in the Peritoneum—Ascites—may be of inflammatory origin (peritonitis with effusion, including tubercular, or even cancerous peritonitis), or it may be purely dropsical in its nature (hydro-peritoneum). In the former case, the fluid is sometimes partially retained in meshes of lymph, or hemmed in by adhesions, so that it does not move freely with changes in the position of the patient; but, as a rule, all cases with much fluid in the peritoneum answer to this test, and the level of the fluid, seeking the most dependent parts, can be marked out by percussion. The intestines, unless bound down by adhesions, float up towards the umbilicus when the patient lies on his back, giving a resonant note on percussion there; but if the fluid accumulation be great, even this region may be dull, only a small area in the epigastrium yielding a clear sound. In the flanks and hypogastric regions, in like manner, the percussion note is dull when

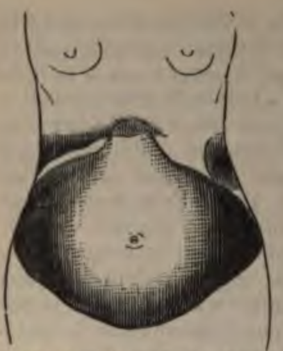

Fig. 40.—The shading indicates the position of the *Percussion-dulness in a case of Ascites*, while the patient is lying on the back, the fluid falling to the low levels in the flanks, and the umbilical region remaining clear.

the patient lies on the back, as these regions are then the lowest; but if this level be marked and the patient be turned quite round, first to the right side and then to the left, the line of dulness will be found to change completely if it be due to fluid freely movable in the peritoneum—first the one flank and then the other becoming resonant, and the dulness shifting at the same time to the parts formerly clear. Certain difficulties beset this test. Occasionally, as already stated, the fluid and the bowels may be hampered in their movements, and so the changes may be less definite. Moreover, when the amount of fluid is small, we may be unable to distinguish the dulness in the flanks, in the midst of the resonance from the over-distension of the intestines with gas, which is so common in abdominal dropsy. Œdema of the integuments often interposes an insurmountable barrier to the detection of slight ascites. Sometimes by pressing away the œdema from a portion of the flank, or by getting the patient to lie for a long time on one side, we may be able to get quit of this complication and ascertain the state of the deeper parts. The condition of the abdominal viscera—a loaded colon, an enlarged liver or spleen, the presence of a tumor, of the gravid uterus, of an ovarian, an omental, or some other cyst, may all give an area of less movable dulness, and impair in this way the value of the test by change of posture: most of these complications usually exist only, or chiefly, on one side, and by dipping the hand down through the peritoneal fluid we can occasionally ascertain the presence of a tumor, and so make allowance for it.

When the quantity of fluid in the peritoneum is small we can sometimes recognize its presence best by placing the patient on his elbows and knees: the umbilical region, quite resonant during examination in the recumbent posture, may then be found to give a dull note in this altered position.

Another test for ascites is the detection of fluctuation.

The flat hand is placed on the side of the abdomen, and with the fingers of the other a sharp tap is directed perpendicularly to the abdominal walls on the other side, when a distinct wave is often both seen and felt. This sign varies much in distinctness in different cases. It is scarcely available except in very considerable dropsy. When the umbilical ring is protruded, as is usually the case in extreme ascites, this fluctuation is often well felt by placing the finger there. This sign of fluctuation may be obtained in the various forms of fluid accumulation in the abdomen, and is not limited to ascites. Moreover, when there is great flatulent distension of the intestines, with tense abdominal walls, a feeling closely resembling fluctuation is sometimes communicated by the air-filled viscera, without the presence of any fluid at all. Of course, the test by percussion comes here to our aid, but it may be said in passing that if the bowel be *greatly distended with air it may give a dull note:* this happens occasionally in intestinal strangulation. A greatly distended bladder sometimes simulates peritoneal fluid, so that it is often wise to empty the bladder by the catheter before tapping or deciding finally on the nature of the fluid accumulation: in the case of a woman, a long flexible catheter should be used, as a silver female catheter might not pass through the elongated neck of the bladder. The mere fact of a patient having recently passed urine, does not always remove the necessity of using the catheter in doubtful cases.

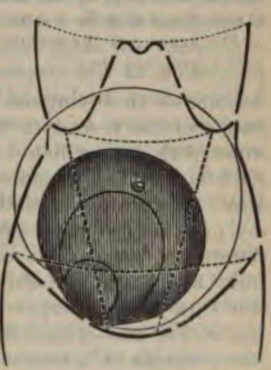

Fig. 41.—Position of an *Ovarian tumor* of the right side, in various stages of enlargement. The shading indicates the ***Percussion-dulness in Ovarian Dropsy of moderate extent:*** the umbilical region is dull, from the presence of fluid, and the flanks remain clear. The outer circle shows a further extent to which the dulness may reach in ovarian dropsy. (After Bright.)

Cystic Dropsy of the Ovaries and other forms of cystic disease often resemble ascites, and they occasionally exist along with it. Ovarian dropsy, in its earlier stages at least, usually affects one side more than the other, and so the distension is not always symmetrical. It leaves, as a rule, one or both of the flanks clear on percussion, and gives a dull note in front, differing thus from the disposition of the dulness in ascites. The umbilical ring is seldom protruded, unless there be coincident ascites. The effect of change of position is scarcely appreciable in ovarian dropsy, or at least it is much less than in ascites. Percussion of the lumbar regions, while the patient rests on her arms and knees, sometimes assists the diagnosis by revealing dulness over the diseased ovary.

Other cystic diseases are discriminated from ascites in a manner similar to that mentioned in connection with ovarian dropsy,—chiefly by their position and by the fluid not being freely movable. Dilated kidney (hydronephrosis), cystic disease of the kidney, and parasitic cysts (hydatids) of the various abdominal organs, including the omentum, are the chief forms of encysted accumulation in the abdomen. Occasionally very soft cancers simulate abdominal dropsy, and colloid material by its escape into the abdominal cavity sometimes gives rise to a semifluid accumulation there.

CAUSES OF ASCITES.—When existing alone, or out of proportion to the dropsy elsewhere, ascites may depend on inflammatory exudations from the peritoneum, or on mechanical obstruction to the mesenteric or portal veins. (When associated with general dropsy, ascites may simply form a part of a more general affection; an examination of the heart and of the urine will assist the diagnosis.)

1. Peritonitis with considerable effusion is almost always chronic or sub-acute. The tenderness which we are in the habit of looking for in inflammation of the peritoneum, is often very slight, or indeed absent, especially if there be much effusion: these cases are usually due to tubercular or, more rarely, cancerous affections of the peritoneum: in the latter, the exudations may be due in part to the compression of veins by the cancerous nodules, and in part to the inflammation set up: this inflammatory element may account for the subsidence of a dropsy in obviously malignant affections. By applying the hand over the abdomen in the umbilical region, and by wriggling it about in various directions and with varying pressure, we can, at times, perceive a crackling sensation, from the rubbing together of rough surfaces, or from the presence of fluid in the meshes of lymph: a similar sense of friction may be conveyed to the hand or to the ear during a prolonged act of inspiration; care must be taken not to confound this sensation with the little noises within the intestines themselves. When such friction can be

made out in a case, it points clearly to inflammatory mischief. Occasionally peritoneal friction can be felt or heard over the liver, and is developed in cases of abdominal dropsy, especially in the terminal stages of renal disease.

As chronic peritonitis, with effusion, is usually tubercular, considerable assistance may often be derived from a consideration of the age, family history, and general aspect of the patient, from the presence of evening pyrexia, and from the concurrence of other symptoms and signs of tubercular disease—tabes mesenterica, ulceration of the bowel, pulmonary phthisis, &c. Cancer is usually associated with but little disturbance of the temperature, but rapidly developed cancer of the peritoneum may run a febrile course.

2. *Tabes mesenterica* is a cause of ascites in children which must never be forgotton; but it is not so common as is often supposed; tubercular peritonitis often resembles this form of disease, and the large belly of rickets is even at times confounded with this formidable disease. Tabes mesenterica is rare under four or five years of age. The dropsy in tabes is usually purely abdominal; any other, if present, can generally be made out to be quite secondary: the distension of the abdominal veins is an important sign of this form of dropsy in the young, but somwhat similar distension is seen in malignant growths in the abdomen, as these likewise obstruct the venous circulation. Occasionally a mass of large mesenteric glands can be felt through the abdominal walls. The general symptoms of wasting disease, and the occurrence of evening elevations of the temperature, the presence of pulmonary phthisis, the existence of abdominal pains, of capricious appetite, of occasional disturbance of the bowels, and the history of any tendency to tubercular disease in the family, must all be carefully considered in doubtful cases.

3. *Portal obstruction.*—Disease of the liver causes ascites from its affecting the portal vein, either in its main trunk or in its ramifications in the hepatic structure. Various diseases of the liver, as well as other affections in its neighborhood, may thus give rise to ascites; indeed, anything which obstructs the portal circulation tends to give rise to abdominal dropsy. The two common affections of the liver thus associated with dropsy are cirrhosis or atrophy of the liver, and cancer. The former, when extensive, leads to the obliteration of so many minute branches of the portal vein, that it can scarcely fail to give rise to dropsy, but in cancer much depends on the accidental position of the malignant nodule

—whether it happens to press on the large veins—in the production of this symptom. Along with cancer of the liver, we must consider cancerous growths in the pancreas, glands, &c., in the neighborhood of the vena portæ, as these can seldom be separated clinically from hepatic affections. Perihepatitis (by compression of the portal vein from the contraction of the lymph effused in its neighborhood) likewise causes ascites; and occasionally enlarged glands in the fissure of the liver complicate amyloid disease, and give rise in this way to ascites. Hydatid cysts, abscesses, and any tumors or swellings in the liver may likewise, from their particular positions, give rise to ascites. Prolonged congestion of the liver—whether of a mechanical nature, as seen in long-standing cases of heart disease, or resulting from the pernicious influence of alcoholic stimulants—is apt to lead to induration of its tissue, and obstruction of the portal circulation, and so gives rise to peritoneal dropsy. Thrombosis sometimes produces a rapidly increasing ascites, and this cause should be considered when the dropsy suddenly assumes an alarming form, threatening asphyxia from its bulk; it is usually due to pre-existent disease in the liver, or other organs concerned in the portal system, but it occasionally arises, as elsewhere, from a very depraved state of the blood.

In investigating these causes of ascites, we try to discover the size of the liver and any peculiarity in its form.

In cirrhosis, the whole organ is usually small, sometimes indeed keeping quite within the margin of the ribs: occasionally, however, it is not diminished in size, and, perhaps, in the early stage it may even be unduly large. The surface of the cirrhotic liver is often uneven, with little projections, seldom exceeding a pea in size; these can be felt in some cases on moving the hand from side to side over the organ, or dipping the fingers down over its edge; not unfrequently there are certain irregularities in the tendinous walls of the abdomen, which are apt to mislead us in such examinations. These nodules in cirrhosis are smaller than those usually found in cancer. The spleen is generally enlarged in cirrhosis of the liver, but this can seldom be made out if there be much fluid in the abdomen. Jaundice, in a pronounced form, is rare in cirrhosis, but the patients have often a dingy or earthy complexion; if present at all, the jaundice is slight, and the bile is not quite absent from the stools, unless, indeed, there be coincident catarrh of the ducts, or some other similar complication. Disturbance of the stomach and bowels, especially vomiting of blood, passing of blood by the bowels, the existence of hemorrhoids, the occurrence of tarry motions, the habitual presence of a sediment of very red lithates in the urine, obvious imperfections in the nutrition, and the previous history of spirit drinking, are the chief points to be inquired for. Spirit drinking is the common cause of cirrhosis of the liver, but it occurs at times quite apart from this habit, and has even been seen in young children. Bleeding from the nose and subcutaneous hemorrhages are also occasional symptoms in cirrhosis of the liver.

In cancer of the liver, the whole organ is usually enlarged, but sometimes only one part appears affected; the surface often presents very distinct nodules of the size of a marble or even larger, with at times a central cup-like depression; these nodules are usually painful and tender on pressure, but cancer of the liver sometimes runs a painless course. This affection of the liver is generally secondary to cancer somewhere else—if judged from the pathological standpoint; but, clinically, it is often impossible to get evidence of any other organ being affected, and even when the liver is involved secondarily, the primary cancer may be in the gall-bladder, the bile-ducts, or other parts intimately related to the liver. Careful search, however, should be made for evidence of cancer elsewhere, and the glandular regions should be explored for any swellings. Hereditary tendencies to malignant disease are sometimes traceable in the family history, but they can but seldom be made out even if really present. Jaundice, like dropsy, is not a constant sign of hepatic cancer, but when deep persistent jaundice, with pale stools, coexists with ascites, it adds great probability to the diagnosis of a cancerous mass compressing both the bile-ducts and the portal vein.

An excessively enlarged spleen is sometimes the only obvious cause of abdominal dropsy.

The examination of the abdomen as to the presence of tumors, or even as to the size of the liver and spleen, is often extremely imperfect, owing to the distension of the parts by fluid accumulation; by dipping the fingers suddenly down through the fluid we may discover an enlargement of the liver and spleen, which might otherwise escape notice. When, however, tapping has been resorted to, an opportunity is afforded, *immediately after the operation*, of exploring the parts, owing to the great flaccidity of the abdomen; the spleen can often be thus felt, and nodulation of the liver then discovered; cancerous masses in the omentum, peritoneum, or mesenteric glands, can often be easily felt at this time although, perhaps, in no other way.

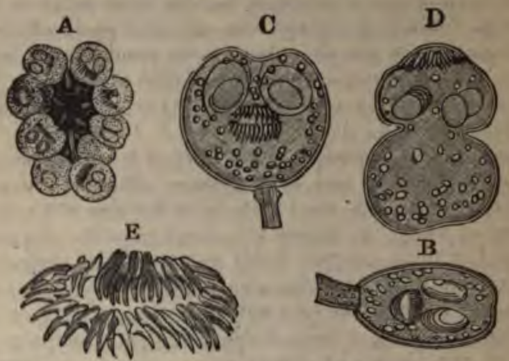

Fig. 42—Human Echinococci. *A*, A group of echinococci, still adhering to the germinal membrane by their pedicles, magnified 40 times; *B*, An echinococcus magnified 107 times; the head is invaginated in the caudal vesicle; a pedicle is attached to it. C, The same compressed; the head contracted, the suckers and the hooks are seen in the interior. *D*, Echinococcus magnified 107 times; the head is protruded from the caudal vesicle. *E*, Crown of hooks magnified 350 times. (After Davaine.)

THE EXAMINATION OF THE FLUID removed by tapping may likewise lead to a diagnosis previously doubtful, but reference must be made to special treatises for full details regarding these various fluids and their characters. The fluid in *simple dropsy* is usually clear, with a specific gravity of about 1012–1015, it contains as a rule but little blood, although highly albuminous; bloody serum has, however, been observed in the dropsy due to portal obstruction. Ascitic fluids vary much in specific gravity (1012–1035), and also in the quantity of albumen which they contain. *In cases of cancer* the fluid may be of the same character as that of simple dropsy, even when the disease involves the peritoneum, but in cancerous cases blood is a more frequent constituent. Lymph (perhaps blocking up the canula) indicates some degree of peritonitis, but all dropsies are liable to set up a certain amount of inflammation in a secondary manner. *A hydatid cyst*—unless contaminated with effused blood and the products of inflammation—yields a clear fluid of low specific gravity about 1007–1009, without albumen or urea, and with abundance of chloride of sodium. Moreover echinococci or hooklets may usually be found on microscopic examination (see Fig. 42). *Urine* may be recognized by its odor sometimes, or by its yielding crystals of nitrate of urea on the addition of nitric acid, after concentration or extraction with alcohol. *Urea* may also be found in the dropsical exudations of the abdomen due to renal disease, so that this test is chiefly applicable to the case of a cyst. Urine from a dilated kidney (hydronephrosis) is usually of a very low specific gravity; it may contain a trace of albumen. The possibility of *complex fluids* from the rupture of cysts, the effusion of blood, and the products of inflammation must be remembered: dark chocolate colored fluids with shreds, &c., coming away on tapping are usually due to such causes.

Somewhat dark colored fluids sometimes slightly, sometimes extremely ropy or even gelatinous, are common in *ovarian cysts*. In such cases we may often see glittering specks with the naked eye shown by the microscope to be scales of cholesterine (see Fig. 43). These are commonly found in encysted fluids, but their presence has been recorded in chronic inflammatory peritoneal effusions also: they assist but do not settle the differential diagnosis of ovarian and peritoneal dropsy. Ovarian fluids may, however, present a close resemblance to peritoneal exudations; they are often clear and sometimes of low specific gravity (especially in parovarian cysts). The specific gravity of ovarian fluids varies from 1003–1045. The detection of "paralbumen" in abdominal fluids has been alleged as diagnostic of an ovarian origin, but this substance has now been found in other forms of disease. "Paralbumen" is not precipitated by heat, although the fluid may become turbid. The action of dilute acetic acid assists its recognition: like mucin, paralbumen is precipitated by this reagent, or at least a turbidity is produced, but the turbidity due to mucin is not dissipated by excess of the acid, or by the addition of a strong solution of chloride of sodium, while the turbidity in the case of paralbumen is dissolved by both of these reagents.

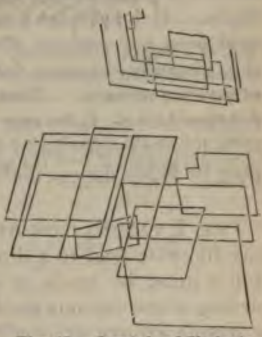

Fig. 43.—Crystals of Cholesterine. (Otto Funke.)

Paralbumen is precipitated by alcohol: so is a substance named "metalbumen," but this latter again is not precipitated by ferrocyanide of potassium and acetic acid as paralbumen is. Some confusion exists as to the reactions of "paralbumen": the various forms of albumen do not seem as yet sufficiently well demarcated. Another test often applied is to boil the fluid, and after obtaining a coagulum, to add strong acetic acid which redissolves the precipitate from ovarian fluids, or renders it gelatinous after it is shaken up.

Mixtures of ordinary albumen and of these altered forms no doubt frequently occur, and tend to confuse the results of the tests.

The microscopic examination of ovarian fluids reveals in addition to the cholesterine crystals already mentioned various cellular structures, pus, blood, epithelial cells, and compound granular masses. Besides these Dr. Drysdale describes a granular cell regarded by him as peculiar to ovarian fluids. It resembles a pus cell, but varies in size: acetic acid does not remove the granular appearance; with ether the granules become more transparent, but the cell is not otherwise altered. These observations require further verification before they can be relied on. Some pear-shaped cells have recently been described by Spencer Wells as occurring in fluids due to malignant ovarian disease.

CHAPTER XIII.

EXAMINATION OF THE URINE AND THE SIGNIFICANCE OF URINARY SYMPTOMS.[1]

THE urine is usually examined to some extent in all hospital cases on admission as a matter of routine. The nature of any further examination is determined by the character of the case. In private practice the examination of the urine is called for on the detection of any suspicious symptoms likely to be associated with urinary disturbances; and the beginner will do well to examine it in all cases where the diagnosis remains doubtful: Patients also frequently complain of changes in the character of their urine; these will be referred to in describing the naked eye appearances (see p. 354).

The routine examination of the urine embraces a note of its reaction, its specific gravity, its color, and other naked eye appearances; also a note of the presence or absence of albumen, and of the character of any sediment, microscopically and otherwise. These points should be *noted* in all hospital cases on admission, even if the results seem purely negative in their indications, as they may be of much value in the subsequent development of the case. The nature of the further investigations depends to some extent on the results of this examination. Thus, if the specific gravity be high, especially in a pale urine, sugar must be tested for and the quantity of urine ascertained. If the specfic gravity be low and the color pale, the quantity passed in the twenty-four hours will be important. In cases with albuminuria some notion of the quantity of the urine is usually desirable to guide not only the diagnosis, but also the prognosis and treatment; sometimes exact measurements of the quantity of the urine are of the utmost value. Special circumstances in the case determine the further investigations. Thus the propriety of an estimation of an abundance of the chlorides in febrile cases, of the urea in various diseases, of the biliary and other pigmentary matters, &c., must be determined by the general clinical features of the case.

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[1] Regarding the examination of the urine the works of Parkes and of Neubauer and Vogel may be consulted. The editions of the latter, subsequent to the translation issued by the New Sydenham Society, may be referred to for the more recent views. The more obscure points in the chemistry of the urine are dealt with very fully by Thudicum in his recent work, and the various quantitative methods of analysis are there given. Watts's Dictionary of Chemistry contains several articles of great value for reference in this connection. Dr. Beale's works are also constantly referred to, and his plates of urinary deposits are of special value.

Dr. Wm. Roberts in his book deals with the examination of the urine in sufficient detail for most purposes, and he goes very fully into the clinical history of the various renal and urinary affections. Dickinson's work on Diseases of the Kidney and Urinary Derangements does not deal with the examination of the urine in detail, but it embraces the various affections of these organs (Part 1, Diabetes; Part 2, Albuminuria; Part 3, Other Affections of the Kidneys, &c.). On Bright's Disease the works of Drs. George Johnson and Grainger Stewart must also be named as of special value.

The work of Dr. Pavy on Diabetes is of great importance; this disease is likewise discussed by Roberts, Dickinson, and Beale.

Surgical treatises must also be referred to regarding diseases of the bladder and certain affections on the border line between medicine and surgery. See, for example, Holmes's "System," Vol. IV.

The samples to be selected for testing depend to some extent on the points specially aimed at in the inquiry. For the reaction, the sample should be quite fresh, and if alkaline the relation of the specimen to meal times must be considered. For the specific gravity the whole quantity passed in the twenty-four hours should be tested, or a sample taken from it. In examining for crystals or tube-casts, the sample should be allowed to settle quietly and completely for several hours. In suspected albuminuria we should examine samples passed at different periods of the day, as in slight cases, the albumen is often absent in the urine passed before breakfast, and appears in considerable quantity after breakfast or dinner. The urine passed in the early morning gives the fairest samples of the secretion, apart from the influence of special meals. In private practice it is a good plan to procure two separate samples passed, the one in the morning, and the other at night. In hospital, the early morning samples may be ordered to be kept in the first instance, and the whole quantity or special samples subsequently ordered, as occasion seems to require. Too much care cannot be taken in securing the cleanness and purity of the samples, both as to the vessels into which the urine is originally passed, and as to the urine glasses and bottles in which the samples are preserved.

Dirty vessels promote speedy putrefaction, and give rise very readily to ammoniacal odor, and to the development of vibriones in urines which would not otherwise present these features so soon. The presence of syrups and the like, in imperfectly washed bottles used for the samples, may give rise to serious mistakes. In hospital practice another danger arises from the samples being contaminated with tube-casts and crystals from the urine of neighboring patients, who may have been using the same vessels.

In some cases of purulent and bloody urine, especially, it is desirable to have the sample passed into two glasses, so as to have the first and second portions separately, as such an examination brings out certain peculiarities in various forms of urinary disease.

QUANTITY.—This varies in health according to the size of the patient, the quantity of fluid he consumes, and the amount of his excretions by the skin, bowels, &c. It may be roughly estimated at from 30 to 50 or 60 fluid oz. in the twenty-four hours. In disease the modifying influences referred to have also some play. In particular, a profuse discharge from the bowels or skin naturally lessens the urine. The quantity of the urine should always be considered in its relationship with the specific gravity, as this sometimes enables us to understand and estimate the value of the changes which occur. Thus in a urine diminished by diarrhœa the specific gravity may rise; in a urine increased from greater quantities of fluid being imbibed the specific gravity may fall. There is often a difficulty in preserving the whole urine passed by a patient, partly from forgetfulness on his part, especially if he be well enough to go about, and partly from the great tendency the urine has to be passed at stool and so lost. By getting the patient to pass water before going to stool this loss may often be prevented, and in male patients a wide-mouthed bottle can easily be used simultaneously. Sometimes, however, the loss is inevitable, both from this cause (as in diarrhœa), and from the urine dribbling away, or from its being passed unconsciously and without warning.

Suppression of urine, or even any great diminution of its amount, is always a serious symptom and fact in disease; but the report is sometimes given that there is suppression of urine when really it is retained in the bladder. When the quantity of the urine is as low as 10 or 20 oz. in the twenty-four hours, it must be regarded as small; it sometimes, however, falls to a few drachms only: when above 60 oz. on several successive days it is decidedly increased. It is well (owing to the confusion arising from various measures in the country) to have the urine measured in fluid ounces, or, if the quantities be large, in imperial pints (20 fluid oz.). When the quantities passed are moderate, they may sometimes be preserved with advantage for our inspection in large glasses graduated in ounces, and in this way the specific gravity of the whole can be readily taken.

SPECIFIC GRAVITY.—This is usually taken by means of the urinometer which is introduced into the sample, in a urine glass, and the level of the fluid on the stem gives the reading, as calculated for a temperature of 60° F., pure water being 1000. The level of the general surface of the urine should be taken and not that of the drop which runs up the stem: it should be seen that the instrument floats freely and keeps clear of the sides and the bottom of the glass. As a rule, we need not be very particular as to the temperature being exactly 60°, but we must not take the specific gravity when the urine is newly passed and so much hotter than this temperature. The stem of the hydrometer should be long, so as to give accurate readings more easily, and as these instruments are often wrong in their graduation some test of their accuracy is desirable, by comparing them with a standard or by the use of the balance. When the quantity is too small to allow of the instrument floating freely, a narrower vessel, or some means of displacing the fluid, may enable us to manage our purpose. The specific-gravity bottle is of course available in the case of the sample being very small, or of greater accuracy being desired, and specific gravity "beads" are sometimes employed. In testing a series of urines, the hydrometer should, of course, be dried to prevent contamination of one specimen by another. As already stated, the specific gravity of the sample noted should be that of the twenty-four hours' quantity, or, if not, allowance must be made for a possible deviation: in many cases the specific gravity of samples passed at different hours varies enormously. The specific gravity must, as already stated, be considered in relation with the quantity passed. *High specific gravities* (above 1025) are found in diabetes (from sugar); in urines with a concentration of the normal ingredients from febrile or other diseases, or from a limited consumption of fluid; in the scanty urine of acute renal dropsy; and in rare cases, from an enormous quantity of albumen being held in solution. *Low specific gravities* (below 1015) occur in nearly all cases (except diabetes mellitus) where the quantity is large, and especially in diabetes insipidus; in cases of lardaceous disease of the kidney, with a large secretion of urine; and in general in all chronic cases of Bright's disease. Temporary depression of the specific gravity is met with in hysterical affections, associated with a profuse flow of urine, and also in the gush of water escaping from a hydronephrosis, and in rare cases, even in the small quantities which succeed in passing the mechanical impediment if both ureters be obstructed: the specific gravity differentiates scanty urine in such cases from that passed in acute nephritis, as in this last affection the specific gravity is always high in proportion to the degree of suppression.

THE REACTION OF URINE is tested with blue and red litmus paper. Normally it is acid; but even in health it may, occasionally, be neutral or slightly alkaline at certain parts of the day, and especially after food containing many alkaline salts. The acidity may be unusually great (as in lithiasis): the degree can be determined by the alkalimeter. In certain depressed states of the general health, in some cases of abundant acid vomiting, in some forms of spinal paralysis, and in long standing disease of the bladder with retention or incontinence, the urine is habitually alkaline, and the reaction has thus a certain value in diagnosis. Normal urine often becomes more acid for some hours after being passed (urinary acid fermentation); but all urines which are allowed to stand long enough decompose and become alkaline, from the conversion of the urea into ammonia, so that we must see to have the samples fresh. Alkalinity from ammonia (volatile alkali) may be discriminated from that due to soda or potash (fixed alkali), by gently heating the test-paper which has been turned blue by the urine, as the volatile alkali is in this way driven off, and the red color returns. The reaction of urine is of value in the recognition of urinary deposits: a bulky deposit which forms soon after the urine is passed may usually be pronounced to consist of uric acid or its salts (urates), if the reaction be acid; if, on the other hand, such a deposit concurs with an alkaline or even a neutral reaction, the probability is that it is phosphatic (the addition of an alkali to normal urine precipitates the phosphates). The persistence of pus in urine of acid reaction points to a renal origin; pus from the bladder, if persistent, usually renders the urine alkaline and ammoniacal. Care must be taken to have the samples fresh in such cases, as urine with much pus, from any cause, rapidly decomposes. Alkalinity of the urine is sometimes a point aimed at in treatment by the administration of potash or other alkaline medicines (rheumatism, lithiasis, gout): the reaction must be determined by *frequent* testing in such cases, as the urine rendered alkaline by remedies readily becomes acid on any interruption or diminution of the dose. On the other hand, medicines seem to have little chemical power in rendering an alkaline urine acid. Benzoic and carbonic acid, however, seem to have some influence in this respect.

THE OBVIOUS CHARACTERISTICS OF URINE are of importance not only as regards the samples we examine ourselves, but also as regards the description or alterations mentioned by patients. Both of these will be considered here. Normal urine has a pale yellow tint, is clear when passed, but deposits, on standing, a *faint cloud of mucus*, which forms only a slight sediment. This mucus is sometimes more abundant than natural, as in slight catarrh of the bladder, and this excess may pass gradually into a deposit of muco-pus. When the cloud is absent, this usually implies some excess in the quantity of the urine, which has thus washed away or diluted the mucus.

The color and clearness of urine vary much. Tables of colors have been devised by Vogel to assist the naming of the variations: he makes nine gradations; pale yellow, bright yellow, yellow; reddish-yellow, yellowish-red, red; brownish-red, reddish-brown, brownish-black. If the urine be turbid, it should be ascertained, if possible, if it were so when passed, or if it only became so afterwards. Turbidity, when freshly passed, may depend on decomposition going on within the bladder, or an excess of vesical mucus, or on the presence of renal epithelium and shreds, pus, blood, semen and prostatic secretions, bile, uric acid, urate of soda (hedgehog crystals), phosphates, chyle or sarcinæ. When the urine is clear on being passed and afterwards becomes turbid, this is usually due to the precipitation of urates or of phosphates, or to decomposition, or saccharine fermentation. When the sediment has completely fallen, sometimes the supernatant fluid is perfectly clear; sometimes it remains slightly turbid from some remaining admixture of the sedimentary matter.

Patients frequently complain of the urine being *high-colored and scanty:* this often arises from simple concentration of the secretion in febrile diseases, apart from any special renal affection, but it also occurs in acute nephritis. Urine *white like milk* is often spoken of in the case of children, and this character is usually due to the presence of white urates or colorless uric acid crystals. In adults, if the urine be *milky when passed*, this is usually due in them to the presence of earthy phosphates (arising, perhaps, from a transient alkalinity of the urine after dinner): unless persistent this is usually of no real importance: or the turbidity may be due to the presence of pus, which is always of more or less serious significance; in rare cases it may be due to chyle, to spermatic fluid or sarcinæ. When the patient describes the urine as "*turning thick*," this is almost always due to a deposit of urates on the cooling of the urine, and is seldom of much consequence. When spoken of as "*resembling porter*," the presence of bile in some quantity is usually indicated, but blood may also give such a color. When described as *turbid and smoky* when passed, this may be due to a slight and intimate admixture with blood, and *blood color* in a more pronounced form, depends on a greater quantity of florid blood being passed; clots may also come away either of a florid color or of a darker hue, or even of a *chocolate* appearance. *Very red urine*, having something of the bloody tint, is sometimes due to excessively red urates, especially as found in certain hepatic cases. *Very pale* urine is found usually when the quantity is habitually excessive, as in diabetes, and in certain forms of chronic disease of the kidney; or it may also concur with a temporary increase in the quantity, from free imbibition of fluids, or in connection with hysterical or nervous attacks in both sexes. Anæmia may also be responsible for the paleness of the urine. *Black* urine is sometimes passed by those using carbolic acid or creasote, either externally or internally; more frequently this black color only appears after the urine has been kept for a time; the addition of a minute quantity of strong vitriol (unpurified) frequently brings out a greenish color in such cases, but this test is rather uncertain. A dark red or almost black color is sometimes formed in the urine in cases of melanosis. *Indigo blue* has occasionally been found in urine after it has been standing for a time and has become alkaline. *Bad odor* in the urine when passed depends, as a rule, on decomposition occurring within the bladder, or on the escape of an abscess into it, and is significant of cystitis, &c. Certain vegetables impart a strong odor to the urine, and the smell of many articles used in the food or drink may be recognized in the urine. In oxaluria a certain resemblance to the odor of sweet-brier may sometimes be recognized, and during the administration of turpentine there is sometimes a smell as if from sweet violets, but these cannot be said to be unpleasant. *Gas* coming with the urine suggests some communication of the urinary passage with the bowels. *Shreds* and fibrous masses may be passed in cases of chronic inflammation of the bladder, or they may come from an inflamed and dilated kidney (Pyelo-nephritis). *Gritty matter or gravel* may also be complained of as coming with urine and irritating the urethra: this will usually be found on examination to be due to uric acid, or, more rarely, to other forms of calculous concretions. *Urinary sediments* usually demand chemical tests or microscopic examination for their discrimination (see p. 380). Sometimes crystals of uric acid can be seen by the naked eye, or with a simple lens, resembling cayenne pepper grains, falling to the bottom of the glass, or adhering to its sides, or to shreds of mucus. Glittering, colorless prisms of ammonio-magnesian phosphate can also sometimes be thus seen floating as a scum on the surface of the urine, or resting on the mucous sediment, or adhering to the sides of the glass. A very delicate and minute powdery sediment covering the top of the cloud of mucus, and resembling, as has been said, fine powder dusted over a wig ("powdered wig deposit"), can sometimes be recognized with tolerable certainty as due to oxalate of lime crystals; occasionally, in alkaline urines, minute phosphatic crystals simulate this appearance; as a rule, however, the latter are more glittering than the former. Fawn-colored, pink or reddish amorphous precipitates, formed as the urine cools, can usually be recognized at once by the naked eye as composed of urates (urate of ammonia, potash, and soda): when the deposit is whitish, there is more difficulty; white urates, or even uric acid, earthy phosphates, and pus, may be scarcely distinguishable from each other by the naked eye. *A glairy whitish or yellowish material*, floating on the surface of the urine, or diffused through it, is often seen when the sample is contaminated with leucorrhœal discharges. Urine with a whitish turbidity *forming a coagulum* on standing is mixed with chyle.

SUGAR IN URINE.

Sugar should be tested for in any complete examination of the urine, and especially in all cases in which, from the symptoms, diabetes is suspected; or when either the quantity of urine is excessive, or the specific gravity is unusually high (above 1030). It should also be remembered that in certain cases of cerebral disease, with or without distinct paralysis, and particularly in some cases of cerebral tumor, sugar appears in the urine. When examining for sugar, albumen should also be tested for, not only because its presence is a serious complication in diabetes, but also because the presence of albumen may interfere with the certainty of the reactions for sugar by the copper test; in such cases the albumen should be precipitated by heating, with the addition of a little acid, and subsequent filtration. Boiling the albuminous urine with crystals of sulphate of soda is likewise said to yield a fluid suitable for the application of the copper test.

COPPER TEST—TROMMER'S TEST.—This is based on the power which diabetic sugar has of reducing copper salts under certain conditions. A few drops of a solution of sulphate of copper are mixed with a little urine in a test tube, excess of liquor potassæ is then cautiously added, just enough to dissolve the precipitate which it throws down in the first instance; the mixture is boiled, and if sugar be present, a red precipitate of the sub-oxide falls down. Errors are frequently made in applying this test from not using the proper relative proportions of copper and potash with the urine.

Fehling's Test Solution[1] (or Pavy's) obviates some of these difficulties. A portion of the test fluid is first boiled in a test-tube to see if it remains unchanged in color (as it is apt to become altered by keeping); if unaffected, a drop or two of the suspected urine is added; if sugar be present in any quantity, the color at once changes, and a yellowish or reddish precipitate comes down. If this does not happen, a little more urine should be added (but always so as to be less than the volume of the test fluid in the tube), and the whole should again be boiled and allowed to cool; if no yellow or red suboxide comes down it may be pronounced free of sugar.

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[1] *Fehling's Solution.*—Sulphate of Copper, 90½ grains; Neutral Tartrate of Potash, 364 grains; Solution of Caustic Soda (of sp. gr. 1.12) 4 fluidounces. Add water to make up exactly to 6 fluidounces. (Or 40 grammes of sulphate of copper in crystals; 160 grammes neutral tartrate of potash; 750 grammes caustic soda, sp. gr. 1.12; add water up to 1154.5 cubic centimetres. Each 10 c. c. correspond to 0.05 gramme of grape sugar.)

Pavy's Solution.—Sulphate of Copper, 320 grains; Tartrate of Potash (neutral), 640 grains; Caustic Potash (potassa fusa), 1280 grains; Distilled Water, 20 fluidounces.

The tartrate of potash and caustic potash are dissolved together in one-half of the water, the sulphate of copper in the other half; the two solutions are then mixed.

Cautions.—Prolonged boiling must be avoided, as reduction may occur in this way apart from sugar. Boiling the urine before adding the test fluid, is also apt to lead to error. Adding too much urine is also to be avoided, as a great excess of non-saccharine urine may reduce the copper. The test fluid must be in good condition—capable of resisting boiling without being changed; in delicate inquiries, it is desirable to add an equal bulk, or more, of pure water to the boiling test fluid, to boil again, and to allow the whole to cool slowly so as to have complete security of the perfect condition of the copper solution.

The Quantity of Sugar may also be determined by the copper test. Fehling's or Pavy s Solutions are made of such strength that 200 grains (by measure) are completely reduced by one grain of diabetic sugar. The test fluid is boiled in a porcelain capsule or a glass flask (a piece of caustic potash, the size of a pea, being added in the case of Pavy's solution) and a quantity of pure water, equal to one or two volumes of the test fluid, is poured in also. The saccharine urine should then be diluted with pure water, in the proportion of 1 volume of urine to 9 of water, if the sugar is abundant; or in a less proportion (or without dilution) if the sugar is scanty. The diluted urine is introduced into a burette, graduated to grains, and is then gradually added to the boiling copper solution till the blue color is quite discharged. In order to judge of this a minute or two must be allowed for the red precipitate to fall, otherwise it obscures the blueness which may remain in the supernatant fluid. When the precipitate falls, by holding up the flask to daylight, or against a white object, or by looking down through the fluid to the white sides of the porcelain dish, if this be used, any remnant of blue color is readily detected. If this can be recognized the mixture is again brought to the boiling point, and a few drops of the diluted urine are again added. Too much time must not be allowed to elapse in waiting for the red precipitate to fall, as after standing for a length of time the suboxide is redissolved, and the blue color is reproduced. The number of grains of urine consumed in the experiment is then read off, and this represents the quantity which contains one grain of sugar; it is then a matter of calculation how many grains of sugar are contained in the ounce of urine (437½ grs. in an ounce avoirdupois). Allowance, of course, is made in the calculation for the degree of dilution employed. If the total quantity of urine passed in the day be known, the total quantity of sugar excreted can then be readily calculated.

FERMENTATION TEST.—Occasionally, from uncertainties in the results of the copper test from various causes, it is important to decide as to the presence of sugar by fermentation; sugar is the only substance known which ferments with yeast and liberates carbonic acid gas. A small tube may be nearly filled with the suspected urine, a little fluid or solid (German) yeast is then added, and the whole filled up with metallic mercury, and inverted over a little of the same metal in a cup; the apparatus is then put in a warm place and allowed some time to ferment. If sugar be present, in other than very minute quantity, gas accumulates in the tube, and this can be shown to be carbonic acid by testing with lime-water. It is well to conduct a blank experiment with simple water and the yeast at the same time, as a security against the gas being formed in any other way.

Torula test.—The detection of torulæ (see Fig. 55, p. 380), occasionally assists in the diagnosis of saccharine urine, or directs attention to its examination by chemical reagents.

The Quantitative Test by fermentation, as described by Dr. Roberts, of Manchester, consists in determining the specific gravity of the urine before and after complete fermentation. A small lump of German yeast (the size of a walnut) is added to four ounces of urine, the specific gravity of which has first been carefully taken and noted; this is placed in a large wide bottle (12 oz.), corked, but with an opening cut in the cork so as to allow the carbonic acid to escape; it is then placed in a moderately warm situation, and in the course of 24 hours, or when the fermentation is completed, it is allowed to cool, and its specific gravity is again taken at the same temperature as before the fermentation was begun. The loss in the specific gravity indicates the quantity of sugar fermented out. The specific gravity is reduced partly by the loss of the sugar formerly held in solution, and partly, perhaps, by some of the light alcohol thus generated remaining in the mixture. To avoid any fallacy from a difference in the temperature of the fluid at the two separate observations on the specific gravity, it is desirable to have a duplicate sample of the original urine, without yeast, in a 4 oz. bottle, firmly corked, and kept beside the other throughout, so as to compare the specific gravity of the two specimens after the fermentation is over. It has been found, empirically, that one degree of specific gravity lost by fermentation, corresponds with one grain of sugar per fluid ounce of urine.

ESTIMATION OF THE QUANTITY OF SUGAR FROM THE SPECIFIC GRAVITY of the urine is, at best, a rough method, as complications arise from the presence, in varying proportions, of the normal solid ingredients of the urine. This source of difficulty is relatively greater when the total quantity of the saccharine urine passed daily is not excessive. A specific gravity which is not excessive cannot, of course, coincide with a high proportion of sugar per ounce. A high specific gravity with a very large quantity of urine (several quarts) may be safely taken as evidence of a high proportion of sugar in diabetes. By doubling the two last figures in the reading of the sp. gr. we obtain a rough estimate of the number of grains of *solids* per 1,000 of urine. (Trapp.)

Moore's Test for Sugar with Liquor Potassæ is a favorite method, on account of its easy application. An equal volume of urine and liquor potassæ are boiled together, when a dark-brown color results in cases of diabetes. This is not a test suitable for small quantities of sugar, and it is subject to fallacies, especially from the presence of lead in the reagent, as this may arise from the bottles used. This test is often of use in confirming our opinions in the absence of more reliable appliances.

Bismuth Test for Sugar. A solution of carbonate of soda is prepared in the proportion of one part of the crystals to three parts of water. This solution is mixed with a little of the suspected urine in equal volumes, and a pinch of the basic nitrate of bismuth is then added, and the whole boiled; if sugar be present the bismuth becomes grayish or blackish from the formation of the suboxide or of metallic bismuth. This test is a delicate one, but is not available for quantitative analysis. (In the absence of the basic nitrate the ordinary subnitrate of bismuth may be employed.)

The Polariscope is available both for the qualitative and quantitative analysis of sugar, provided the fluid be decolorized and freed from any other ingredients (such as albumen) which act on polarized light; but the instruments as yet are rather troublesome and expensive, at least in their accurate forms.

ALBUMINURIA.

The tests for albumen relied on in clinical medicine are two, and they should, as a rule, both be applied, at least in all doubtful cases. They are (1) Boiling, with the subsequent addition of a drop or two of acetic or nitric acid; and (2) The application of strong nitric acid to the cold urine. Various other agents precipitate albumen, and are used for special inquiries—Corrosive Sublimate, Ferrocyanide of Potassium, Alcohol, Ether, Chloroform, Chromic Acid, Picric Acid, Carbolic Acid, &c. Some of these have been introduced into clinical medicine, and may perhaps be used occasionally with advantage; but the clinical significance of the precipitates obtained from some of them remains still so doubtful that we fall back with the more confidence on the two methods named above, which have stood the test of long experience. It should be seen to that suitable samples are examined before pronouncing the absence of albuminuria. (See p. 350.)

1. *Test by heat.* The urine, clear (if possible), is heated in a test-tube to the boiling point, and a drop or two of strong acetic or of nitric acid are then added. If albumen be present there is a turbidity, or a precipitate, which does not dissolve on adding the acid. If the amount of albumen be small, by heating the upper half of the fluid in the test-tube we sometimes can demonstrate the reaction more clearly. If the urine be turbid from urates, these dissolve on a slight application of heat to the whole quantity in the tube (say 98° F.). The test is not interfered with by this. If the turbidity of the urine cannot thus be got rid of, filtering may be resorted to. Occasionally a degree of turbidity remains which interferes with the delicacy of this test for minute quantities of albumen.

Apart from this, which is only a slight imperfection, some fallacies in the heat test may mislead the student. (*a.*) Albumen may be present, but, being held in solution by alkalies, it may not come down on heating. Hence the propriety of trying the reaction before boiling, and the necessity of adding acid after boiling, before deciding on the result. (*b.*) A precipitate may form on heating, somewhat resembling albumen, but really consisting of earthy phosphates; such a precipitate is soluble on adding a little acid, a precaution which should never be neglected in applying this test. (*c.*) If too much acid be added to the boiling urine in testing the precipitate which forms, this may dissolve even albumen; excess need not be risked, as the smallest quantity suffices to dissolve earthy phosphates. (*d.*) Occasionally a minute trace of nitric acid in the test-tube with the sample of urine (remaining perhaps in badly washed test-tubes), prevents the precipitation of albumen on boiling. Sometimes the addition of even a little acetic acid to the urine before boiling likewise prevents the precipitation of albumen by heat, and so this should be avoided; even a great natural acidity of the urine itself has been known to prevent the precipitation of albumen by heat. The reaction of the urine for the correct application of this test should be just slightly acid. Any acids used to secure this must be applied with caution; in rare cases alkalies must be used to neutralize undue acidity.

2. *Nitric acid added to the cold urine* forms a test for albumen of great value. The delicacy of this test in pale urines of low specific gravity is quite marvellous. The strong nitric acid may be added to a small quantity of urine in a test-tube, ten or twelve drops of the acid being allowed to trickle down the side of the tube; the test-tube should be held obliquely, so as to avoid, if possible, the commingling of the fluids. The acid falls to the bottom, and can usually be recognized from its different color, or (on shaking it very gently) from its obviously different specific gravity. Another way is to introduce the nitric acid first, the lighter urine being then poured down very slowly and cautiously, so as to float, without mixing much with the acid. With either method albumen, if present in the urine, forms a cloud just above the level of the acid; or if the quantity be minute, a ring of haziness appears at the junction of the two fluids. A third way of applying this test is to introduce a little nitric acid by a pipette (the outside of the pipette being wiped free from acid) right down to the bottom of the urine in the test-tube. All these methods aim at getting the action of the acid localized to a part of the urine without being diffused through it. (A ring of red color merely, without turbidity, at the junction of the fluids does not indicate albumen. This is sometimes very marked, and, when highly developed on boiling the acid and urine together, constitutes the "Urohæmatine" supposed by Dr. Harley to be due to the loss of blood, as it were, in a disguised form.)

Certain fallacies and difficulties beset the nitric acid test also:—(*a.*) If the quantity of albumen be minute, some time occasionally elapses before the haziness is developed. The tube should be left at rest for a few minutes before pronouncing that there is no haze of albumen. (*b.*) Occasionally, on adding nitric acid to the cold urine, a more or less dense precipitate occurs, not from albumen, but from urates. This usually appears first near the surface of the urine, and not at its junction with the acid, although it often extends that length. A very gentle heat suffices to dissolve this precipitate of urates; this may be done by immersing the tube in warm water: in applying heat for this purpose we must avoid anything like a boiling temperature, as albumen itself dissolves if boiled with excess of nitric acid in the tube. A further confirmation of such a precipitate being due to urates may often be obtained by getting a similar reaction on adding a drop or two of acetic acid, as this does not precipitate albumen in cold urine. (Occasionally, indeed, an albuminous principle resembling caseine is thus precipitated by acetic acid.) The microscope may sometimes also assist us. The precipitate of amorphous urates may be recognized as such by the microscope; sometimes crystals of uric acid are quickly formed. (*c.*) When the urine is turbid, the delicacy of this test is lost. Filtering no doubt may assist us in such a case, but besides being troublesome it is apt to be imperfect in its effect. When the turbidity is due to urates (the commonest cause), by heating very gently, a clear fluid can be obtained on which to operate, and by keeping the tube slightly warm (in warm water or in the warm hand), this clearness may be maintained long enough for the satisfactory application of the test. (*d.*) A precipitate formed at the bottom of the acid consisting of nitrate of urea seldom presents any difficulty in distinguishing it from albumen; it is crystalline, readily soluble at a very gentle heat, and usually it takes a long time to form, although it sometimes appears in a few minutes when the urine is loaded with urea.

The quantity of albumen may be roughly estimated by judging of the extent of the precipitate formed on boiling, especially after it has been allowed to subside in the tube for a definite time (say twenty-four hours): its amount may be thus estimated at a half, a fourth, an eighth, &c. Sometimes the quantity is indicated by saying a "trace" of albumen, or "slight," or "moderate," or "large" amounts, as the case may be; or that the urine is solidified on heating. Such indications are of clinical importance, but the estimate thus made has little chemical value. The estimation by precipitation and weighing is so troublesome as to be practically unavailable in clinical medicine.

The quantitative determination of albumen by nitric acid, as proposed by Dr. William Roberts, is based on the fact that the reaction with this test takes longer to show itself in proportion as the albuminous solution is dilute. Indeed, in very slight degrees of albuminuria several minutes are required to bring out the haze with nitric acid. The test consists in diluting an albuminous urine to such an extent that the haze becomes perceptible in a definite time, when a definite quantity of urine is treated with a definite quantity of nitric acid, in a tube of a definite width. The quantity used is 5 cubic centimetres of the fluid in a test tube ⅝th of an inch (15 mm.) in its internal diameter: the nitric acid is applied by a pipette drawn to a point, holding 10 or 12 minims when immersed to the depth of 2 inches: the acid is discharged against the side of the tube while it is held at an angle so as to prevent any mixing of the fluids: the dilution aimed at is such as to give rise to a haze appearing not sooner than 35 seconds and not later than 45 seconds. The tube must be held up to the daylight and watched carefully with some black object, such as a coat sleeve, in the vicinity. If the reaction appears before 30 seconds, more dilution is required; if not till after 45 seconds, less dilution must be employed. A drachm measure for the urine and a pint measure for the water serve the purpose of diluting, and these fluids must of course be well mixed. If higher dilutions are required, the drachm of urine may first be mixed with one or two volumes of water before the further dilution in the pint measure is begun. One or two rough experiments before beginning careful dilution may guide us as to the number of volumes with which we should begin. Most albuminous urines can stand at least one volume of water being added, so as to give this reaction in the time named (35—45 seconds); some may require as much as 200 or even 300 volumes of water to bring them to the necessary state of dilution. The state of dilution required for the reaction within the time named is termed the "zero;" each volume of water required to be added is termed a "degree" of this scale. The value of each degree was calculated by the balance to be equivalent to 0.0034 per cent. of albumen. If then a urine showed 250 degrees of albumen we multiply by this fraction;—thus 250×0.0034=0.85 per cent. of albumen; if we wish to calculate the total loss of albumen per day, we multiply the number of ounces passed by the 437½ grains contained in an avoirdupois ounce, multiply this again by 0.85 (as determined above) and divide by 100: this gives the answer in grains of dry albumen.

In applying this method we must, of course, obtain a proper sample of the whole urine passed in the twenty-four hours.

In addition to the estimation of the total albumen passed in a day, this method supplies by its varying scale of degrees some definite figures instead of vague expressions as to the abundance of albumen in urine, as "20 degrees," "60 degrees," "100 degrees," "200 degrees," &c. (See Medico-Chirurgical Transactions, vol. LIX. London, 1876.)

THE CLINICAL SIGNIFICANCE OF ALBUMINURIA is very variable; it is sometimes of the utmost importance in diagnosis, and at other times of scarcely any account.

When due to the presence of blood, pus, &c. (as revealed by the microscope), the clinical significance of the albumen turns of course on the significance of these ingredients, and must be considered under these headings. Sometimes, however, the amount of albumen seems out of proportion to the amount of blood, or pus contained in the sample: in such cases the want of a good quantitative test for albumen is much felt, but an experienced eye can usually judge pretty safely from a consideration of the variations noticed with different quantities of pus or blood. Sometimes obvious variations in the blood-color in different samples from the same case, with but little change in the quantity of albumen precipitated on heating, leave no doubt as to the existence of albuminuria, apart from, and in addition to, the blood and pus present.

Many acute febrile diseases often give rise to albuminuria for short periods, without the diagnosis or prognosis being seriously affected thereby. In typhus and enteric fevers, smallpox, diphtheria and malignant sore throat, erysipelas, pneumonia, pleurisy, pericarditis, acute rheumatism, meningitis, acute tuberculosis, puerperal fever, and acute suppurations of various kinds, albuminuria is often detected, but it must be regarded as one of the features of the general disturbance, rather than a symptom with local significance.

After the primary fever of scarlatina and occasionally after smallpox, enteric fever, and erysipelas, albuminuria is observed as a recognized sequela. In the case of scarlatina indeed, it may be said to be of habitual occurrence, and when it appears in a member of a family affected with this disease, or when conjoined in the individual himself with desquamation of the cuticle, arthritic pains, hydrothorax and other well-known sequelæ of scarlatina, it often enables us to recognize an attack of scarlet fever in a patient who would not otherwise be supposed to have been so affected.

In pregnancy and the puerperal state albuminuria is not infrequent, and although not necessarily of grave import, it is always significant of possible dangers (convulsions during labor, chronic renal disease, &c.).

Chronic chest complaints are often complicated with albuminuria, and this has great importance as regards prognosis (chronic bronchitis, emphysema, chronic pneumonia, pleurisy, or empyema, heart disease, aneurism, mediastinal tumors, &c.). Sometimes in such cases the albuminuria is only one of the indications of a general venous congestion which may pass off quickly; sometimes of a nephritis established through the long continuance of this renal congestion; sometimes, on the other hand, the renal disease, of which albuminuria is the sign, may be justly regarded as the primary fact, and the thoracic affection as a complication.

In all dropsies the presence or absence of albumen is important. Occasionally genuine renal dropsy exists without albuminuria, but this is so rare as to make such a diagnosis improbable, or, at least, it demands very special proof.

Albuminuria, on the other hand, may be regarded as presumptive proof of a renal origin for the dropsy, in whole or in part, but it may be secondary, as just explained, to general venous obstruction due to cardiac, hepatic, or ovarian disease, or to dropsy of the peritoneum, or any other cause giving rise to direct pressure on the renal veins.

In acute or chronic renal disease of all kinds, whether with or without dropsy, the detection of albuminuria is of the greatest value: concurrent evidence from the presence of renal derivatives in the urine (tube-casts, epithelium, &c.), from alterations in the specific gravity and the quantity of the secretion, and from the general features of the case, may come in here to help the diagnosis.

In nervous diseases, the existence of albuminuria is of importance, but the nature of its connection with such cases is variable. Sometimes the nervous affection is a tolerably direct manifestation of the renal disease (uræmic convulsions, coma, blindness, or delirium): sometimes the nervous affection is due to organic changes associated with the renal disease (hemiplegia due to cerebral hemorrhage associated with hypertrophy of the heart and disease of the kidney). At other times, albuminuria may be regarded as an effect of the nervous disease, as in the temporary albuminuria due to an epileptic or other convulsive fit, or as in the albuminuria produced by certain forms of inflammation, tumor, or other lesion of the brain.

In many chronic and constitutional affections we must watch for albuminuria; phthisis, syphilis, scrofulous disease of the joints and bones, and profuse suppurations generally, are often associated with albuminuria due to lardaceous degeneration of the kidneys. Cases of chronic indigestion and depressed states of the health, with habitually alkaline urine, or with persistent deposits of oxalate of lime, gouty attacks and the like, must be particularly watched in respect of this symptom, both because of the frequent complication of such cases with albuminuria, and because symptoms of the class just indicated are often the earliest manifestations of renal disease. Other chronic diseases as diabetes, jaundice, cancer, exophthalmic goitre, and lead poisoning are often complicated with albuminuria.

Remedial agents, especially *blisters*, may give rise to a transient albuminuria, sometimes with, sometimes without hæmaturia and strangury.

In the midst of so many possible sources of albumen in the urine we must fall back on the general symptoms and features of the complaint to guide our diagnosis; and in particular, we must have regard to the persistence and to the quantity of the albumen. and to other evidences of derangements in the urine, as respects its quantity, its specific gravity, its color, and the presence of tube-casts, renal or other epithelium, pus, blood, crystals, parasites, &c.

BLOOD IN THE URINE

is always to be regarded as important. Sometimes its appearance is so far accidental; thus the possibility of the admixture of menstrual blood with the urine, or of slight bleeding from the use of the catheter, must be borne in mind; the possible existence of more serious injuries to the genito-urinary organs must not be ignored, although these do not belong to purely medical practice.

Blood in the urine can often be recognized by the eye as giving a dingy or smoky tint to the urine, especially when the blood comes from the kidney and is intimately mixed with it. Sometimes it has a darker hue, resembling chocolate. All gradations of red and florid blood-color, with or without clots, may be found, especially when the blood comes from the pelvis of the kidney, the ureter, or bladder. When the blood is present in any distinct quantity the existence of an albuminous reaction may be calculated on with certainty, and the presence of this may serve to confirm our suspicion of blood, while the absence of albumen should make us suspect some fallacy as to the blood-tint. Occasionally, however, the appearance of a very distinct blood-color may co-exist with the merest trace of albumen: indeed, it may happen that a reduction in the amount of albumen coincides with the appearance of blood in the urine in very distinct quantity. The microscope assists the diagnosis of hæmaturia by determining the presence or absence of blood corpuscles, and these may often be seen in cases in which no albumen can be detected by the tests. The red blood corpuscles are recognized by their size being smaller than that of pus, or mucus, or white blood corpuscles, and by their having the double outline due to the biconcave character of the discs (Fig. 44, *b*). It frequently happens, however, that the discs are swollen up, by absorption of fluid, into a globular form, and this peculiarity is consequently lost: occasionally their edges are serrated from similar physical causes (Fig.

44, *a*, *d*). Sometimes the corpuscles are so disintegrated that they cannot be seen, although the coloring matter is abundantly present in the urine; in such cases there may be chocolate-colored clots in the sediment: in these cases the presence of albumen in quantity assists us (Hæmatinuria.) A fallacy is not unfrequently presented by globular vegetable spores closely simulating the microscopic appearance of red blood corpuscles.

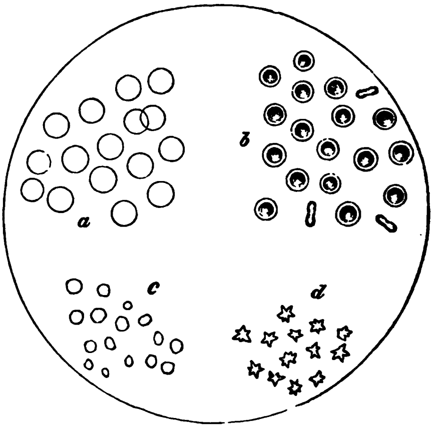

Fig. 44.—Blood corpuscles in urine. *a*, Slightly distended by imbibition; *b*, Showing their biconcave contour; *c*, Shrivelled; *d*, Serrated. (Dr. William Roberts.)

A chemical test for blood (and for hæmoglobin), by means of guaiac, is sometimes of value, although subject to fallacies of its own. Two or three drops of the urine are placed in a test tube, a single drop of tincture of guaiac is added, and a few drops of ozonic ether are then shaken up with the whole. The ether dissolves the precipitated resin, or goes to the surface and carries up with it a distinct bluish color if blood be present. It is alleged that this reaction can also be obtained from minute traces of hæmoglobin in the urine, even before the albumen appears, in scarlatinal dropsies. This test is sometimes applied by means of white bibulous paper dipped in the urine, the guaiac and ozonic ether being subsequently applied to the paper when it has dried. If this method be followed, the paper itself must first be tested with pure water, as some papers give a misleading reaction; high-colored urine, from bile, may also mislead.

CLINICAL SIGNIFICANCE OF HÆMATURIA.—The appearance of blood in the urine (apart from the accidental contaminations from the vagina, &c., already referred to) points either to some general disease, attended with bleeding, as in the case of purpura, scurvy, or of some forms of disease affecting the bloodvessels generally; or it may be due to the operation of some poisonous agency acting specially on the kidneys, —such as cantharides, turpentine, creasote, and alcohol; or to some local affection of the urinary organs and passages themselves,—such as inflammation of the bladder or kidneys, cancer of these organs, parasitic disease of the kidney, renal embolism, calculus of the kidney or bladder; occasionally it is due to the extension or bursting of abscesses, cysts, &c., into some part of the urinary tract from adjacent structures.

The further discrimination of such cases turns on the aspect of the blood, whether intimately mixed with the urine, or florid, or in clots; whether passed chiefly with the first or the second half of the urine at a given time; whether associated with an excess of mucus or mingled with pus, and if so, whether the pus is extremely variable in amount at different times, whether the reaction of the urine is habitually acid or alkaline when passed, and whether any urinary gravel, microscopic calculi, tube-casts, or parasites, are present in the sediment. The kind of epithelium found along with the blood is often of consequence, if we can recognize it as renal or vesical, or as coming from the pelvis of the kidney or the ureter. The quantity and specific gravity of the urine, likewise, assist in determining the presence of acute or chronic disease of the secreting parts of the kidney. The detection of tube-casts in a bloody urine always points to a renal element in the case, but it is quite possible that even in such cases the bladder may be responsible for most of the mischief, for the renal affection may be secondary to disease working its way back from the urethra and bladder. Again, if we can satisfy ourselves that there is more albumen in the urine than can be accounted for by the blood present, this also points to a renal affection. Of course, the general symptoms of the case must be strictly inquired into, especially as to pain, its site, its area of distribution, whether over the pubes, in the lumbar and sacral regions, in the thighs, the region of the ureters, or in the penis, and testicles; the relationship of the pain to the act of micturition, or to any supposed cause of its development, must also be considered. (A surgical examination of the urethra, prostate, and bladder, is often demanded to settle the questions here raised, at least in cases of persistent or frequently recurring hæmaturia, associated with painful micturition.) The occurrence of shiverings, the circumstances under which the hæmaturia appeared, — whether after scarlatina, or in the course of chronic or acute renal diseases, or associated with hemorrhages elsewhere, or after a fit of drinking, or in connection with the use of special drugs, or after injuries to the parts, or in connection with renal colic or tumor, and tenderness in the loins,—all these must be inquired into; their special significance must be sought for in the description of urinary diseases in the text books.

PUS IN THE URINE

occurs sometimes as a microscopic deposit only; at other times it appears in sufficient quantity to present a very distinct and even a bulky sediment. In such cases it may often be recognized by the naked eye, but it is apt to be confounded with phosphatic deposits (especially as it often exists along with them), and it may be confused with white urates. Liquor potassæ, as a reagent, may often assist in the discrimination; for urates are dissolved by this agent, phosphates are but little affected or rendered more dense by it, while pus becomes ropy or gelatinous on the addition of an equal bulk of liquor potassæ to the purulent deposit; the impossibility of pouring out such a mixture drop by drop is good evidence of this ropiness. Sometimes the pus assumes this ropy character soon after the urine is passed; this is due to the development of ammonia, which acts on pus in much the same way as liquor potassæ does; sometimes the ropiness exists when the urine is passed, from the ammoniacal decomposition going on within the bladder itself. The microscope is useful in revealing the presence of pus corpuscles; these when seen may be further tested by the addition of dilute acetic acid, which clears up the granular contents and brings out the tripartite nucleus. (See Fig. 45.) Other white cells are often found in urinary sediments which can scarcely be distinguished from pus; the white corpuscles of the blood, mucus corpuscles, inflammatory corpuscles (leucocytes), and even altered renal epithelium, all resemble pus so closely as to be at times indistinguishable from it. We may judge of the probability of such cells being white blood corpuscles by the presence or absence of the red corpuscles; of their being mucus corpuscles by the mucous appearance or otherwise of the sediment; renal epithelial cells are usually larger than pus, and the action of acetic acid sometimes assists in various doubtful cases. The reaction of purulent urine, when of renal origin, is usually distinctly acid (if tested immediately on being passed), even in long-standing suppuration; it is usually alkaline and ammoniacal in long-standing suppuration from the bladder. When of renal origin, the deposit of pus in the urine glass is often very distinctly demarcated from the supernatant fluid; in vesical suppuration, whether from calculous irritation or not, it is usually more diffused and mingled with mucus; in both cases it may be mingled with blood in various degrees and ways. In renal suppuration, the blood when present usually lies in a distinct layer on the top of the pus; in vesical cases, the blood is often more mixed up with the mucus and pus. Sounding of the bladder is imperatively called for in all doubtful cases with bladder symptoms. The co-existence of mucus, of fibrous shreds, of crystals of various kinds, and of epithelium from the kidney, ureter, bladder, or urethra, is sometimes of great value in judging of the origin of the pus. If much scaly epithelium from the vagina be present, leucorrhœal contamination should at once be suspected, and the use of the catheter may be required to overcome the difficulty of this admixture. Sometimes in the male, instructive hints may be gathered from the relative abundance of pus in the first half of the urine as

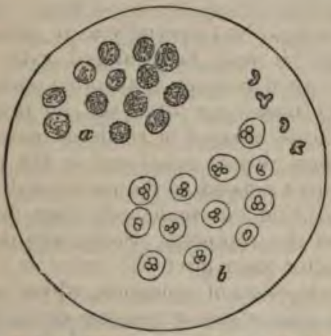

Fig. 45.—Pus corpuscles. *a*, Without reagents; *b*, After the addition of acetic acid. (Dr. Wm. Roberts.)

compared with the second, from a single act of micturition; any pus in the urethra is naturally washed away with the first half of the urine, while if the seat of suppuration be in the bladder, it is rather more abundant in the second half, and may be more contaminated with blood. In suppuration from a dilated kidney the quantity of pus often varies in a remarkable way at different acts of micturition, and some information may be gained by procuring a series of samples in separate glasses. Albumen can be made out by the tests in all cases of excessively purulent urine—from the presence of the pus itself; but when we can make out a greater amount of albumen than the pus can well account for, there is a strong case for the renal origin of the complaint; we may find, for example, the same quantity of albumen present in various samples, although the pus may vary greatly and may even reach an insignificant amount in certain specimens. It is, however, often very difficult, or even quite impossible, to get clear evidence of this, and when blood as well as pus is present, the determination of an independent albuminuria, in addition to these, becomes impossible. As already explained in the case of hæmaturia, the detection of tube-casts is of great value in determining the presence of renal mischief of some kind; but these casts are found in cases of renal irritation from calculus and gravel as well as in Bright's disease and the other destructive lesions of the kidney. A tumor in the loins, when present, often indicates for us the source of the pus in the urine (pyonephrosis); and the kind of crystals found in the sediment may guide us to a diagnosis of the nature of the concretion in cases of calculous pyelitis, and of stone in the bladder.

THE CLINICAL SIGNIFICANCE OF PUS IN THE URINE resembles somewhat that of hæmaturia, and it is equally varied. It may follow acute renal inflammation, and it often appears in cases characterized by copious albuminuria and in cases of Bright's disease following fevers and parturition. It occurs also in renal embolism. As already indicated, the pus may proceed from abscesses in the substance of the kidney, or from suppuration of its pelvis, due to calculus, or to secondary mischief working its way back from the bladder or urethra. Pelvic and other abscesses opening into the urinary tracts, cystitis, whether of calculous or paralytic origin, cancer of the bladder, inflammation and suppuration of the prostate, gonorrhœa, and gleet, whether recent or of old standing, may all give rise to purulent urine. Accidental contamination from lochial or leucorrhœal discharges must also be remembered as a possibility.

RENAL TUBE-CASTS

should always be searched for in cases of albuminuria. They are present in the great majority of cases in which the albumen has a renal origin, but they are occasionally so scanty as to be difficult of detection. The specimen of urine examined for this purpose should have had time to settle thoroughly, or for several hours at least: the supernatant fluid should be cautiously poured off in such a way as not to disturb the deposit, or, if we have any further occasion for it, some of the sediment may be removed from the bottom by the pipette, and a drop placed on a slide with a cover glass may be examined microscopically with a quarter-inch lens. This suffices when the casts are moderately abundant, the only precautions required being careful illumination and focussing. Many casts are so transparent as to be almost invisible in a strong light, and some shading, by moving the mirror, may be required to allow of their being caught by the eye. When scanty, a good plan is to put several drops of the sediment in a shallow cell with a cover glass, and examine with a low power (half-inch objective) ; or to place a drop or two of the sediment on a slide, spread it out (without a cover glass), and pass the whole rapidly in review. If a doubtful structure is seen, requiring a higher power, it can be placed quite in the centre of the field, and the stronger lens brought down upon it : or, as the object glass is thus apt to dip into the fluid, an attempt may be made to place a cover glass over the doubtful structure, and after finding it as before with the low power, we may come down upon it with a stronger lens to define its character. In this way several drops of the sediment may be examined in rapid succession, and tube-casts detected which would otherwise have escaped notice. By filling the pipette with the sediment, and allowing it to settle, either by plugging the upper opening or by leaving it to stand in the urine, we sometimes obtain a better specimen for microscopic examination when the sediment is scanty and the tube-casts few in number. In other cases again, where the field is crowded with cellular or other objects, dilution with a little water facilitates the search for casts. If pipettes are used, care must be taken to have them well cleaned; owing to the uncertainty attending this cleansing of narrow tubes, it is often better to pour off the urine and examine a drop of the deposit placed directly on the slide. Shreds of mucus, aggregations of the amorphous granules of urates, and vegetable growths sometimes assume forms which simulate tube-casts.

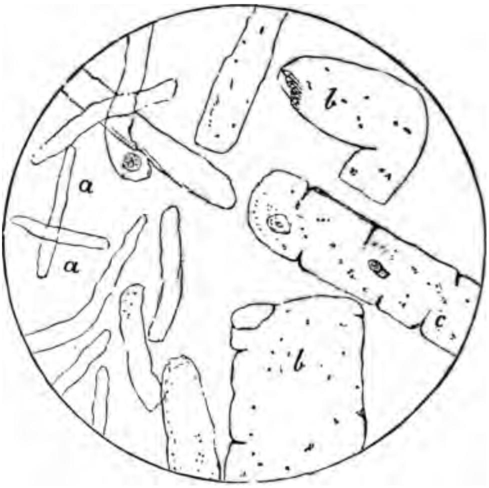

Fig. 46.—Hyaline, or waxy casts. *a*, From a case of chronic Bright's Disease of eight months' duration. *b*, From a case of chronic Bright's Disease (large white kidney). *c*, From a case of chronic Bright's Disease (contracted kidney, with fatty degeneration). (Dr. Wm. Roberts.)

Tube-casts are of very various sizes, both as regards length and breadth. When of large diameter this should be noted, as it is a point of some importance, as indicating a certain dilatation of the renal tubules. They may be (1) perfectly "hyaline," *i.e.*, clear, transparent, and empty (see Fig. 46); (2) they may be packed full of rows of renal epithelial cells —"epithelial casts" (see Fig. 47, *a*); (3) the cells thus contained may be quite fatty, with obvious oily globules within them, or such globules may lie within the cast—"oily or fatty casts" (see Fig. 48, *a*); (4) the fatty element may be in such a minute state of division as to present only a dark granular appearance—"granular casts" (see Fig. 47, *b*). Various stages or gradations of these four varieties are met with, sometimes even in different parts of the same cast.

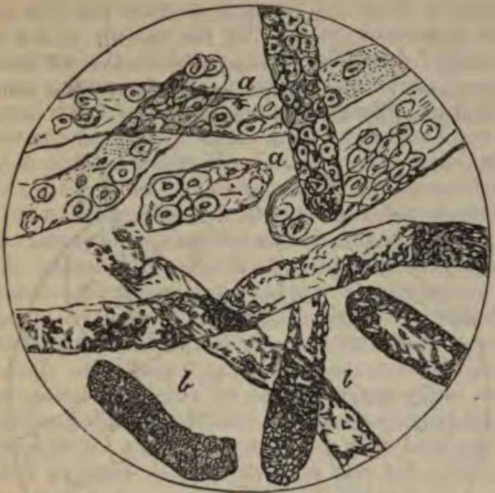

Fig. 47.—*a*, Epithelial casts. *b*, Opaque granular casts, from a case of acute Bright's Disease. (Dr. Wm. Roberts.)

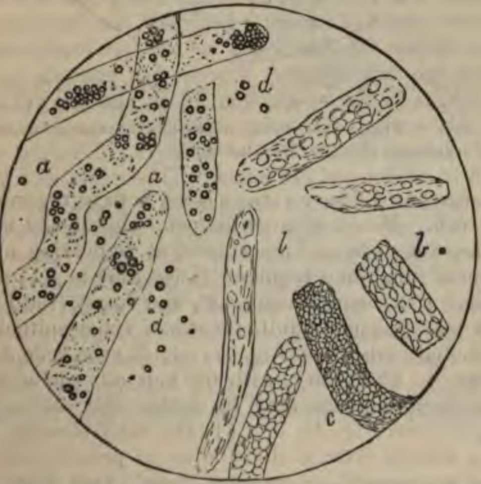

Fig. 48.—*a*, Fatty casts. *b* and *c*, Blood casts. *d*, Free fatty molecules. (Dr. Wm. Roberts.)

In addition to these (5) the casts may contain blood-corpuscles, and sometimes the coloring matter only of the blood—"blood casts" (see Fig. 48, *b*); and in the same way (6) "pus casts" are sometimes seen. In estimating the significance of these different kinds of casts too much importance should not be attached to a single specimen; the character of the majority of the casts should rather be kept in view.

THE CLINICAL SIGNIFICANCE OF TUBE-CASTS is sometimes considerable, not only in the differentiation of various forms of renal disease, but as indicating the actual existence of a renal affection in cases involved in doubt. Thus, in bloody or purulent urine (as explained under these headings), where the origin of the blood or pus is obscure, the existence of tube-casts clearly points to a renal element in the case, wherever the blood may come from. It does not, however, imply the existence of Bright's disease, as renal tube-casts may be associated with the irritation, arising from a calculus, and they are then sometimes found with blood and crystals, but not necessarily with either. Tube-casts are found in jaundiced urine, quite apart from any serious renal affections, and, as a rule, apart even from albuminuria. With regard to the different kinds of casts we may say, in a rough way, that epithelial casts and blood-casts are found in the earliest stages of an acute nephritis, but very soon thereafter we obtain hyaline casts as the predominating type, and when the inflammatory process has gone on to produce fatty changes in the epithelium, these changes are reflected in the tube-casts. Granular casts are found in advanced cases of chronic disease of the kidneys. Hyaline casts occur both in recent and old cases. Tube-casts, as a rule, are abundant in cases of acute desquamative nephritis, less abundant in the more chronic forms, and usually scanty in the lardaceous form of renal disease. The exact forms of albuminuria, of renal origin, in which tube-casts are really absent, cannot be strictly defined: but when inflammatory changes are absent, mere congestion probably gives rise to but few casts (transient passive congestion, exophthalmic goitre, &c.). There is reason to believe that a tube-cast may occasionally be detected in urine which is practically normal.

EPITHELIUM

of various kinds is often found in urinary sediments on microscopic examination, and it is of great importance to detetermine its character, and if possible its origin. *Renal epithelium* lying loose is recognized as being somewhat globular, and it can sometimes be compared with epithelium contained within tube-casts in the same microscopic field. (See Fig. 47, *a*.) Occasionally it resembles pus corpuscles, and can scarcely be discriminated from them. Its presence forms an important element in the diagnosis of desquamative nephritis, both acute and chronic. It undergoes various changes, the cells appearing atrophied, or granular, or distinctly fatty. Sometimes large *granular corpuscles* are found along with fatty epithelium: these corpuscles indeed are themselves probably altered epithelial cells. Changes of this kind in the epithelium shed from the kidneys are very suggestive of the processes going on in these organs. (See Fig. 49.)

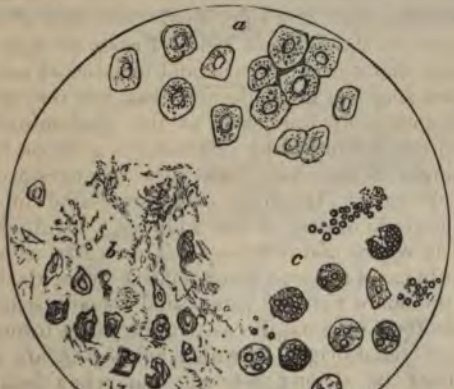

Fig. 49.—Renal Epithelium. *a*, Natural appearance. *b*, Atrophied and disintegrated renal cells. *c*, Renal cells in a state of fatty degeneration. (Dr. Wm. Roberts.)

Cells from the bladder often appear as groups of tesselated epithelial cells of circular form: sometimes they are pyramidal. (See Fig. 50.)

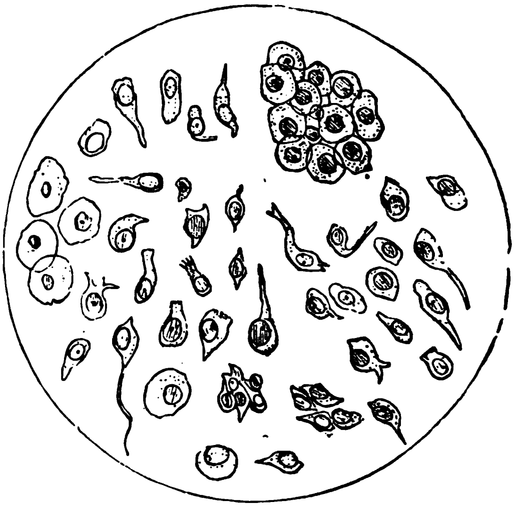

Fig. 50.—Epithelial cells from the bladder, ureter, and pelvis of the kidney. (Dr. Wm. Roberts.)

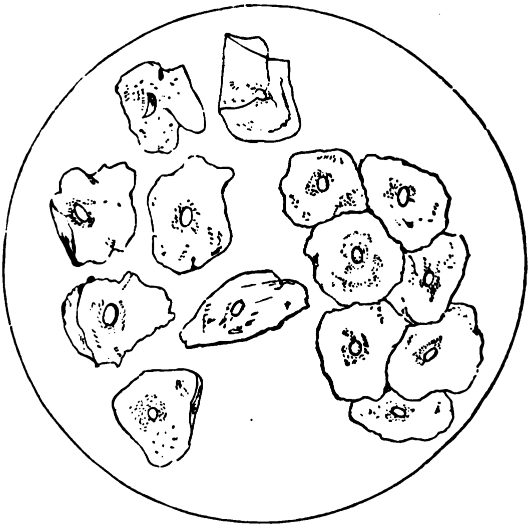

Fig. 51.—Vaginal epithelium in the urine. (Dr. Wm. Roberts.)

Tailed epithelium is found in the ureter and pelvis of the kidney, and sometimes the recognition of such is of value in the diagnosis of calculous pyelitis. (See Fig. 50.) *Large scaly epithelium* is often present as a contamination from the vagina. (See Fig. 51.)

SPERMATOZOA, BACTERIA, HAIRS, FIBRES, &c.

Spermatozoa are occasionally seen in varying numbers in the urine. They appear in large numbers in the urine after seminal emissions, whether physiological or morbid, and a few are often introduced into the urinary passages during straining at stool, &c. When present habitually they may afford evidence of spermatorrhœa. (See Fig. 52.)

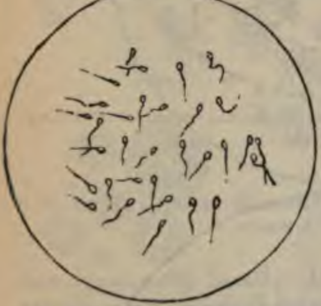

Fig. 52.—Spermatozoa. (Dr. Wm. Roberts.)

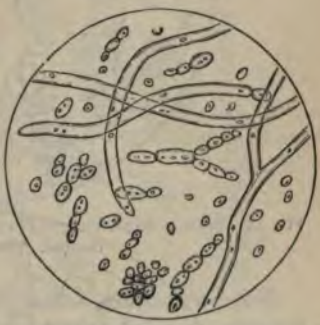

Fig. 54.—Mould Fungus. Sporules and Thallus. Dr. Wm. Roberts.)

Bacteria, fungi, &c.—Bacteria and vibriones appear readily in urines which stand some time, and appear more quickly if the reaction of the urine be alkaline or if the vessels used be imperfectly cleaned. They may be found in freshly passed urine if decomposition be going on within (in cases of paralysis of bladder requiring catheterization, &c.) (See Fig. 53.)

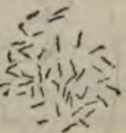

Fig. 53.—Vibriones in urine (Dr. Wm. Roberts.)

Fungi of various kinds, with branching growths, are often found; these sometimes resemble tube-casts. Spores of globular shape likewise appear in various aggregations: when single, they resemble blood corpuscles. The rapid appearance of sporules (torula) sometimes directs attention to the possibility of the urine being saccharine, but torulæ appear in urines in which sugar cannot be detected. (See Figs. 54 and 55.)

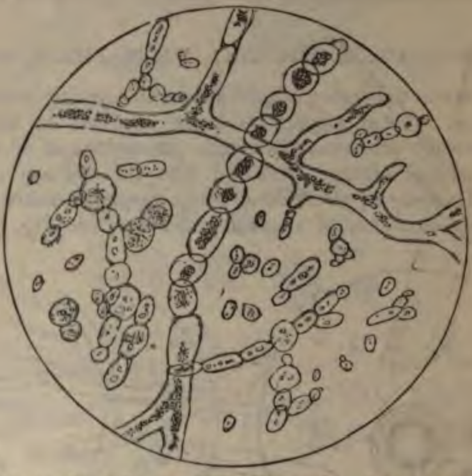

Fig. 55.—Yeast or Sugar Fungus (Torula Cerevesiæ). Sporules and threads of thallus. (Dr. Wm. Roberts.)

Foreign matters.—Cotton, flax, fibres, straw, hairs, and feathers are often present in minute fragments from floating dust from the bedding, &c. Air-bells and oil globules (perhaps from an oiled catheter or an oily bottle) often puzzle the beginner. (See Fig. 56.)

CRYSTALLINE AND AMORPHOUS DEPOSITS.

Uric Acid can frequently be recognized as a red sand in the urinary deposits, lying at the very bottom and in the corners of the glass, or sometimes adhering to the sides, or entangled in the mucus. Although usually highly colored, the uric acid crystals thrown down from pale urines are sometimes almost colorless: uric acid itself is without color, it only attracts the pigment of the urine. The forms presented by uric acid crystals are very variable, but they may mostly be reduced to modifications of the rhomb. The plates of Dr. Beale give excellent representations of the variations and forms of aggregation usually met with. The following names applied by Dr. Roberts to the crystals may assist in their recognition:—quadrangular and oval tablets, cubes, six-sided tablets, lozenges and barrel-shaped figures, stars and spikes, and fan-shaped crystals. (Compare Fig. 57.)

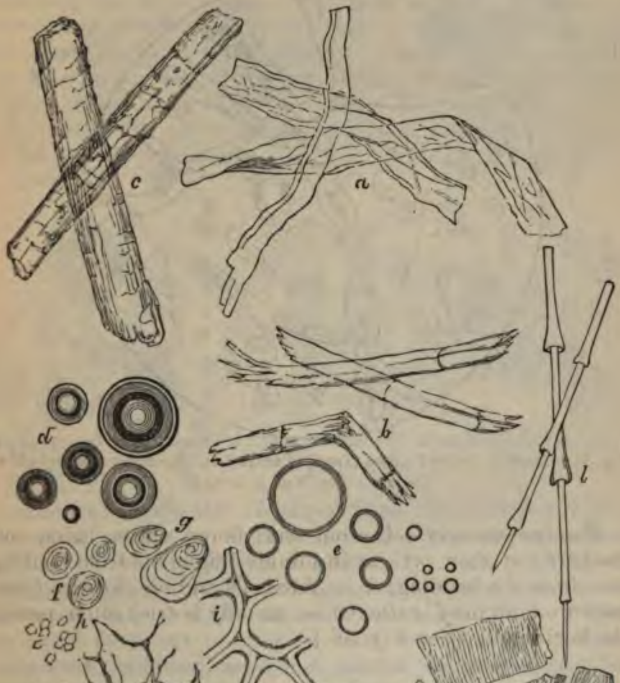

Fig. 56.—Extraneous matters found in Urine:—*a*, Cotton fibres; *b*, Flax fibres; *c*, Hairs; *d*, Air bubbles; *e*, Oil globules; *f*, Wheat starch; *g*, Potato starch; *h*, Rice-starch granules; *i*, Vegetable tissue; *k*, Muscular tissue; *l*, Feathers.

The presence of a high color often leads us to suspect the nature of crystals which would otherwise be puzzling, and the detection of transition forms from well-known shapes often serves to confirm our conjectures. Uric acid is very insoluble in water, and it does not disappear on heating the sediment,—a distinction from the deposit of urates. Uric acid is not dissolved by acetic acid: this serves to discriminate colorless uric acid from certain crystalline forms of phosphate of lime. Uric acid is soluble in caustic alkalies, and alkalies administered internally often exercise a solvent power. Uric acid is sometimes passed, as crystals, from the bladder, and these may then be seen in the fresh urine as red particles, or as causing a general turbidity: they are, however, more often only formed and deposited by the urine after standing for a time: this being due partly to the cooling of the urine and partly to its increasing acidity after it is passed. The crystals often increase in size after a time. The addition of a drop or two of strong acid to normal urine precipitates uric acid in crystals. Sometimes the precipitate thrown down by the addition of acid to urine consists of a dense mass of amorphous urates which may resolve itself by and by into uric acid crystals. A sediment of uric acid crystals, on being kept till it becomes alkaline, may be converted into hedge-hog crystals of urate of soda.

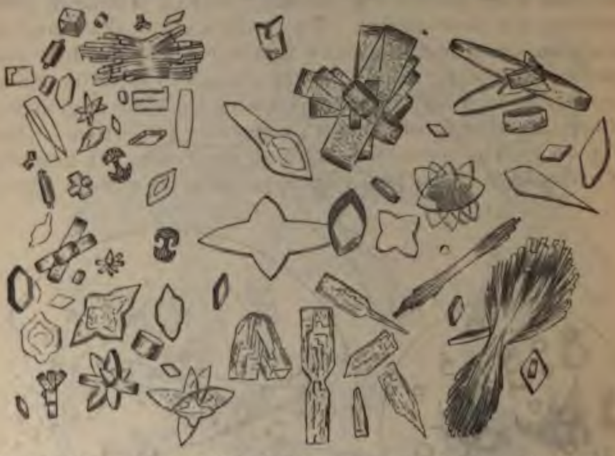

Fig. 57.—Various forms of Uric Acid Crystals. (Selected from Otto Funke's Physiological Atlas.)

URATES OR LITHATES are salts of uric acid combined with soda, potash, or ammonia, the exact composition being often very difficult of determination: these bases would seem often to be mixed together. Such sediments in the urine are extremely common. They are found in urines which are clear when passed, but become turbid on cooling or after standing for some hours. They are occasionally found in newly passed urine, especially in the cases of children who pass milky-looking urine, but in such cases this sediment, of *urate of soda*, is crystalline, presenting the form of globules, either simple or furnished with hedge-hog projections. (See Fig. 58.) The common form, however, consists in granules of *amorphous urates* (see Fig. 59); these often form aggregations so as to assume the shape of ropes or strings, simulating occasionally granular tube-casts. The microscope cannot always discriminate amorphous urates from an amorphous deposit of earthy phosphates, but the reaction usually settles the point: urates are deposited on cooling from acid urines: phosphates are found with an alkaline or at least a neutral reaction. The use of liquor potassæ likewise assists, as also the action of heat; both of these dissolve a sediment of urates, but leave phosphates unaffected or may even render such a sediment more dense. The sediments of urates are usually fawn-colored, or pinkish, or even as red as blood. The chemical causes of the precipitation may be considered as connected with the cooling of the urine, its concentration

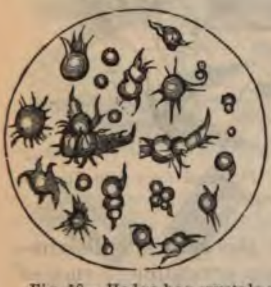

Fig. 58.—Hedge-hog crystals of Urate of Soda, spontaneously deposited from the urine of a child. (Dr. Wm. Roberts.)

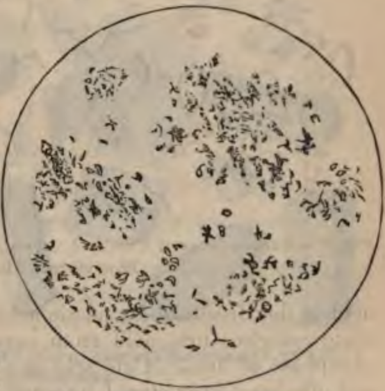

Fig. 59.—Amorphous Urate deposit. (Dr. Wm. Roberts.)

(from febrile disorders or from scanty supply of fluid), and also with the increasing acidity of the urine after it is passed. Adding a little acid sometimes precipitates urates in a urine in which they are deposited spontaneously in the course of a day or two. The internal administration of alkalies or diluents often accounts for the disappearance of these sediments under observation.

PHOSPHATES appear in two distinct forms, amorphous and crystalline: the crystalline phosphates are of two classes, the crystallized phosphate of lime and the ammonio-magnesian (or "triple") phosphate. The phosphatic deposits often form a white sediment somewhat resembling pus.

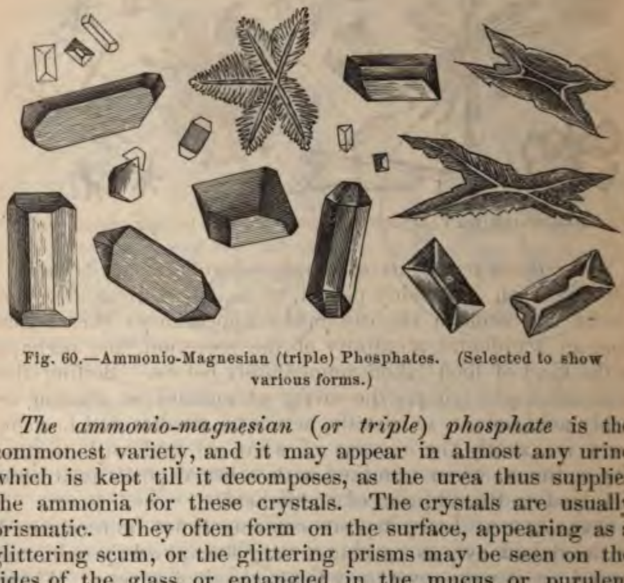

Fig. 60.—Ammonio-Magnesian (triple) Phosphates. (Selected to show various forms.)

The ammonio-magnesian (*or triple*) *phosphate* is the commonest variety, and it may appear in almost any urine which is kept till it decomposes, as the urea thus supplies the ammonia for these crystals. The crystals are usually prismatic. They often form on the surface, appearing as a glittering scum, or the glittering prisms may be seen on the sides of the glass, or entangled in the mucus or purulent sediment. The reaction of such urine is usually alkaline, but it may be neutral or faintly acid. Such crystals are sometimes to be seen in the urine as it is passed, especially associated with pus, and with an ammoniacal odor, from the decomposition going on within the bladder. The forms of the crystals, although essentially prismatic, undergo various alterations, and sometimes they assume a feathery appearance. (See Fig. 60.)

Crystallized phosphate of lime appears usually as stars or rods, or as fan-shaped crystals, destitute of color: other forms are also occasionally met with. The action of acetic acid is sometimes useful in distinguishing them from uric acid crystals, as the phosphates are dissolved by this acid and uric acid is not. (See Fig. 61.)

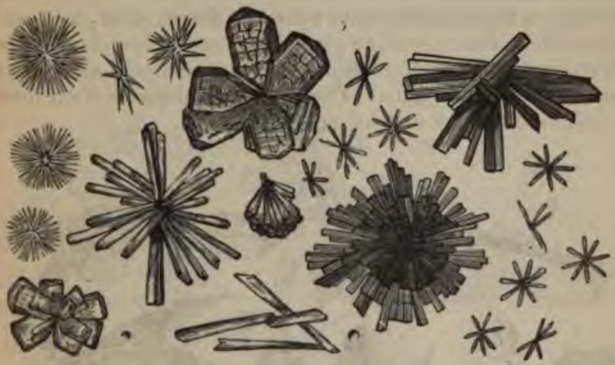

Fig. 61.—Crystallized Phosphate of Lime. (Selected to show various forms.)

Amorphous sediments of earthy phosphates are occasionally met with in freshly passed urine, apart from disease, giving the urine a slightly milky appearance: this arises from an accidental alkalinity of the secretion, due perhaps to the kind of food taken immediately before. Boiling the urine often precipitates the earthy phosphates in alkaline or feebly acid urines, so that the action of alkalies and heat on them is exactly the reverse of what we find with urates. The sediment when unmixed with other deposits is at once dissolved on the addition of acetic acid.

Oxalate of Lime deposits can sometimes be recognized by the naked eye as causing a very fine powdery sediment dusted, as it were, over a delicate cloud of mucus. These sediments occur in acid urines and disappear if the urine be rendered alkaline by medicines. The crystals are octohedral in shape, but appear at times in somewhat different forms (single or double pyramids). Occasionally they are found in the form of dumb-bell, or ellipsoidal, or reniform crystals. (For the various forms see Fig. 62.)

Oxalate of lime crystals are sometimes passed as such from the bladder (indeed the dumb-bell crystals are alleged to be sometimes formed within the tubules of the kidney), but oxalate of lime is usually crystallized out of the urine after it has passed, and the dimensions of the crystals can often be seen to increase with keeping. Oxalate of lime is insoluble in acetic acid; this is at times useful in distinguishing some of the unusual forms from phosphates. Aggregations of minute crystals or miscroscopic calculi are sometimes formed of minute dumb-bell or pyramidal crystals.

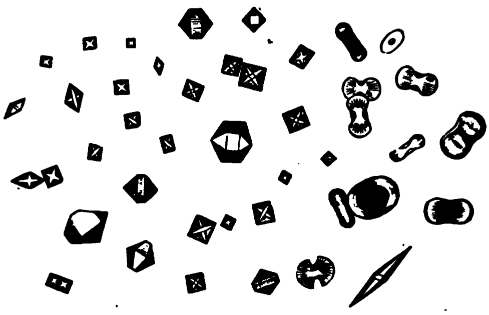

Fig. 62.—Oxalate of Lime Crystals. (Selected to show various forms.)

OTHER CRYSTALLINE DEPOSITS are occasionally found in urine; *Carbonate of lime* in little balls, *Cystine* in six-sided tablets, *Tyrosine* in needles, *Cholesterine* in scales, &c., but these are all somewhat rare.

THE CLINICAL SIGNIFICANCE OF AMORPHOUS AND CRYSTALLINE DEPOSITS is not so great as that of pus, blood, and tube-casts.

Uric acid occurring habitually as a sediment, or even the persistence of *urates* as a deposit, indicates a derangement in the health, pointing to some error in the digestive or hepatic functions, and having perhaps some relation to the gouty diathesis (Lithiasis, Lithæmia). Very red urates are so frequently associated with liver disease as to be useful in directing attention to this organ. The occasional occurrence of urates on the cooling of the urine has no real importance, and uric acid crystals may likewise appear, at a time, without any special significance. It is the habitual or excessive occurrence of these which is important. They sometimes appear at the crisis of fevers, &c.

Oxalates of lime, in like manner, when deposited habitually and excessively, and in urines loaded with urea, is often found associated with a train of nervous and dyspeptic symptoms which have been grouped together and named "oxaluria," and are supposed by some to indicate an "oxalic acid diathesis." Oxalates are frequently present in the urine in nervous affections of various kinds. It must be understood, however, that a few oxalates frequently appear in the urine apart from any obvious derangement of the health. The uric acid and the oxalic acid diatheses seem to have certain affinities; the former is certainly hereditary; it seems to be interchangeable with the latter in some members of the same family, and perhaps at different periods of the same person's history.

As associated with signs and symptoms of renal and vesical culculus and gravel, the appearance of either uric acid or oxalate of lime crystals is often of great importance in diagnosis and in guiding the treatment. These crystals, when associated with blood, tube-casts, or pus, often point to the site and nature of the illness. The hedge-hog crystals of urate of soda may likewise be sources of renal and vesical, or urethral irritation, and of calculus.

Crystallized phosphate of lime has been supposed to indicate the existence of serious organic disease attended with waste of tissue (phthisis, diabetes, paralysis). It certainly is frequently met with in serious nervous affections.

The triple phosphates (ammonio-magnesian phosphates) have not much significance unless when detected in freshly passed urine; they then indicate that a process of decomposition is going on within the bladder; they may likewise indicate the nature of visical concretions in the process of formation.

Persistent deposits of the amorpohus earthy phosphates being associated with habitual alkalinity of the urine, are not unfrequently the index of a depressed state of health; they may also tend to vesical concretions. A similar remark applies to *carbonate of lime*. *Tyrosine crystals* are occasionally found in typhus and other fevers, and especially in cases of acute yellow atrophy of the liver; the urine usually requires to be evaporated down to obtain these crystals. The clinical significance of *cystine* is not yet clearly made out; it may form the nucleus of a calculus.

SCHEME OF SYSTEMATIC QUALITATIVE ANALYSIS OF URINARY CALCULI (*Thudicum*).

Powder the calculus. Heat a small portion of the powder to redness on some platinum foil, and observe whether any residue is left which will not burn off.

A. In case it leaves a fixed residue, take a small portion of the original calculus, dissolve in concentrated nitric acid, evaporate to dryness on a water bath in a white porcelain evaporating dish; dip a glass rod into the strongest ammonia, and bring it near the residue in the dish, and observe whether a pink color is produced or not.

I. A pink color is produced, proving that the calculus contains *uric acid;* observe whether a portion of the calculus melts on being heated.

a. It melts—

(1) And communicates a strong yellow color to the flame of a spirit lamp or Bunsen burner; *sodium urate.*

(2) And communicates a violet color to the flame, giving the potassium spectrum; *potassium urate.*

b. It does not melt; dissolve the residue left after ignition in a little dilute hydrochloric acid, add ammonia till alkaline, and then ammonium carbonate solution.

(1) A white precipitate falls; *calcium urate.*

(2) No precipitate: add some hydric sodic phosphate solution; a white crystalline precipitate falls; *magnesium urate.*

II. No pink color is produced. Observe whether a portion of the calculus melts on being heated strongly:—

a. It melts (fusible calculus). Treat the residue with acetic acid: it dissolves; add to the solution ammonia in excess; a white crystalline precipitate falls: *ammonio magnesium phosphate.* In case the melted residue is insoluble in acetic acid, treat with hydrochloric acid; it dissolves. Add to the solution ammonia; a white precipitate indicates *calcium phosphate.*

b. It does not melt; moisten the residue with water and test its reaction with litmus paper; it is not alkaline. Treat with hydrochloric acid, it dissolves without effervescence. Add to the solution ammonia in excess, white precipitate: *calcium phosphate.* Treat the calculus with acetic acid; it does not dissolve. Treat the residue after heating with acetic acid, it dissolves with effervescence: *calcium oxalate.* Treat the original calculus with acetic acid, it dissolves with effervescence; *calcium carbonate.*

B. The calculus on being heated does not leave a fixed residue. Treat a portion of the calculus with nitric acid, evaporate and expose to ammonia vapor as before.

I. A pink color is developed.

a. Mix a portion of the powdered calculus with a little lime and moisten with a little water; ammonia is evolved, and a red litmus paper suspended over the mass is turned blue; *ammonium urate.*

b. No ammonia; *uric acid.*

II. No pink color is developed.

a. But the nitric acid solution turns yellow as it is evaporated, and leaves a residue insoluble in potassium carbonate; *xanthine.*

b. The nitric acid solution turns dark brown and leaves a residue soluble in ammonia; *cystine.*

BILE IN URINE

can often be recognized by the eye when present in any quantity. Moreover, when testing for albumen by nitric acid, the peculiar greenish reaction produced by bile usually attracts attention. More delicately applied, this test with nitric acid consists in placing a drop or two of urine and a drop or two of strong nitric acid on adjacent parts of a white plate, and allowing the one to run into the other. The commingling of the fluids should be closely watched in good daylight, when a beautiful play of colors is observed—including brown, green, blue, violet, red, and yellow. Or, a little acid may be dropped on the urine as placed on a plate, or on a white sheet of note paper, when a similar reaction occurs. This test applies only to ***bile pigment.***

A test for the ***biliary acids*** has been introduced, but it does not give reliable results as applied to urine. Two drachms of urine are introduced into a test tube, a small piece of loaf sugar is added, and a drachm of strong sulphuric acid is poured gently down the sides of the glass; if the biliary acids are present, a deep purple color is produced at the line of junction; a brown instead of a purple color indicates their absence. This test, however, has not been found of much clinical value.

The Clinical Significance of Bile in the Urine corresponds with that of Jaundice (see p. 332). Its presence or absence assists in the differentiation of discolorations of the skin or of the conjunctiva, due to other causes. It likewise seems occasionally to indicate an incipient jaundice before the tissues generally are affected, and its disappearance from the urine sometimes affords evidence that the attack is passing off, although the jaundice elsewhere may still remain very visible. The presence of bile pigment may serve to explain, so far, the existence of tube-casts in urine, as already noticed, under the heading of Tube-Casts, or, at least, to give their presence a less serious significance (see p. 376).

CHLORIDES

are always present abundantly in normal urine. They are often diminished, or almost suppressed, in several febrile diseases, especially in pneumonia. The quantity may be roughly determined by adding a little of a strong solution of nitrate of silver to the urine, along with a few drops of strong nitric acid. The denseness of the precipitate, or its relative abundance when the sediment falls down, serves to indicate the quantity; a sample of normal urine, treated in the same way, may be used as a basis of comparison. This precipitate of the chloride of silver (insoluble in nitric acid) is soluble in ammonia. Albumen, if present, must be separated before testing for chlorides, as it also is thrown down by nitrate of silver.

THE ESTIMATION OF UREA

contained in urine affords valuable data in certain physiological and pathological inquiries. It has been made out, however, that the quantity of nitrogen eliminated by the urine depends more on the quantity taken in as food than on anything else, so that if we aim at scientific precision, an analysis of the food taken is almost required to give value to the quantitative analysis of the urea. Albumen, if present, should be separated by boiling, before beginning the estimation of the urea. The natural excretion of urea may be quoted roughly at 500 grains per day for a male adult, or 3½ grains per pound weight of his body (33.18 grammes, or .500 gramme per 1 kilo. of body-weight).

The specific gravity of the urine (in the absence of sugar) usually gives a fair indication of the quantity of urea being excreted. Occasionally, by the rapid crystallization of nitrate of urea, on the addition of nitric acid to the urine, we have evidence of its presence in excess. For very accurate results, probably the best plan is to determine the *total nitrogen*, by the ordinary processes followed by chemists in an ultimate organic analysis; but this, of course, is not available in clinical practice.

Two volumetric processes for the estimation of urea are employed, both of which afford moderately accurate results.

LIEBIG'S MÉTHOD is based on the principle of the precipitability of urea by mercuric nitrate, and further, on the circumstance that the white precipitate thereby produced is not decomposed, and therefore not turned yellow by carbonate of sodium. (This yellow color results from the formation of oxide of mercury, or basic nitrate of mercury, or carbonate of mercury.) It is necessary also to separate from the urine, before operating on it, the phosphates and sulphates, so that the urine requires first to be prepared by treating it with baryta-water and a solution of nitrate of barium. A further preliminary proceeding consists in determining the quantity of chloride of sodium present, as the reaction does not occur till the whole of the chloride of sodium is decomposed and converted into nitrate of sodium. This may be estimated by noticing the amount of mercurial solution added from the burette before the white precipitate begins to appear; or the amount may be determined more accurately by precipitation with silver. A further difficulty arises from the fact that this mercury process is only accurate when the proportion of the urea in solution amounts to two per cent., so that an allowance must be made in carrying out the process when the results indicate that more or less than this amount is actually present.

It is somewhat difficult to prepare accurately in its proper strength the solution of mercuric nitrate; indeed, the most satisfactory way is to dilute a solution of pure mercuric nitrate so as to correspond with a definite quantity of urea when this has been ascertained by precipitation from a pure solution of urea in water. The solution may also be purchased from certain makers. (Griffin, Bunhill Row, London.)

DETAILS OF LIEBIG'S METHOD.—(Dr. Michael Foster, Watts's Dictionary of Chemistry, "Urine," vol. V., p. 966, London, 1874.) *Prepared urine* (if albumen be present it must be separated by boiling, some urea will probably be lost). Two volumes of urine are mixed with one volume of a "baryta mixture" (consisting of two volumes of baryta-water to one volume of a solution of barium nitrate, both saturated in the cold), and filtered.—*Urea-solution:* 2 grammes of pure urea are dissolved in water and the solution diluted to 100 c. c.—*Mercurial solution:* a concentrated solution of pure mercuric nitrate is diluted with four times its bulk of water. 10 c. c. of the urea solution are measured into a beaker, and the mercurial solution is slowly added from a burette as long as any precipitation takes place; a drop of the mixture is then let fall by a glass rod into a drop of a solution of sodic carbonate (say about 20 grains to ounce) placed in a watch-glass, or on a glass plate, over some black surface. If the precipitate which occurs on the mingling of the two drops does not become in a few seconds distinctly yellow, more of the mercurial solution must be added to the mixture in the beaker and the trial made again. As soon as a distinct yellow color appears (the shade being noticed by the observer in order to guide him afterwards), the trial drops are returned into the beaker, and a little of the soda-solution added until the mixture is only faintly acid. A drop is then again to be tried with the soda-solution, and if the yellow color does not show itself, a small quantity of the mercurial solution must still be added to the mixture in the beaker and the trial made again. When the yellow color has been thus obtained, the total quantity of mercurial solution used is read off;

it corresponds to .2 gramme urea. The mercurial solution itself is then diluted according to these results, so that 20 c. c. of it correspond to 10 grammes of the urea solution, *i. e.*, so that 10 c. c. correspond to .1 gramme urea. It is well not to add, at once, the whole of the water required, but to stop a little short of that and titrate again, since practically the degree of dilution required is rather less than that suggested by calculation.

Method. Of the *prepared* urine 15 c. c. (corresponding to 10 c. c. of the original urine) are poured out into a beaker or flask, and the mercurial solution is added until the yellow reaction, as described above, is obtained; the mixture is also in the same way reduced in acidity and trial made again. The quantity of mercurial solution used will give the amount of urea in the 10 c. c. of urine. Unfortunately the reaction is exact only for fluids containing 2 per cent. of urea; its appearance is premature when more, and is delayed when less than that percentage is present. If the prepared urine contains an *excess* of urea, double its volume of the mercurial solution will have been used and yet no reaction set in. Hence if, on arriving at this point, 1 c. c. of distilled water be added to the mixture for every additional 2 c. c. of the mercurial solution employed, the proportion of urea will be maintained at 2 per cent., and the final result will be correct. Thus if after the addition of 30 c. c. of the mercurial solution to 15 c. c. of the prepared urine the reaction is not seen, 1 c. c. of distilled water is added and the process continued. Supposing the reaction finally sets in when 10 c. c. more, or 40 c. c. in all, of the mercurial solution have been used, the 5 c. c. of distilled water, which have been also added, will bring up the original 15 c. c. of urine to 20 c. c.; the 40 c. c. of mercurial solution will have been employed on a fluid containing 2 per cent. of urea.

If the prepared urine contains *less* than 2 per cent. of urea an approximate correction may be made by subtracting .1 c. c. from every 5 c. c. of the mercurial solution that is run short of the normal 30 c. c. Thus, if with 15 c. c. of prepared urine the yellow color is struck on using 20 c. c. of the mercurial solution, .2 c. c. $(30—20=5\times 2)$ are deducted, and therefore 19.8 c. c. taken as the correct result. A further correction must be made for chloride of sodium, the presence of which delays the reaction. We may make an approximate correction by deducting from the quantity of mercurial solution employed 1.5 c. c.–2.5 c. c., according to the quantity of chloride of sodium present. Or we may first remove the chloride. To 15 c. c. of prepared urine one or two drops of solution of neutral chromate of potash are added, and a solution of nitrate of silver dropped in from a burette, until the appearance of the red chromate of silver indicates that the whole of the chloride has been thrown down; the mercurial solution can then be at once used without removing the silver precipitate. The reduction in the percentage of urea by the addition of the silver solution must of course be taken into account. Or two proportions of prepared urine may be taken of 15 c. c. each. One is neutralized with nitric acid, the mercurial solution added, and the point marked at which a permanent precipitate (a distinct cloud, not a mere opalescence) is produced. The other is titrated in the usual way. The number of c. c. employed in the latter, minus those employed in the former operation, will give the real quantity of urea.

It must be remembered that other nitrogenous bodies, creatinine, allantoin, &c., are precipitated by the mercurial solution in the same way as urea.

Hypo-Bromite of Sodium Process for Estimating Urea.—Davy's process (by hypo-chlorite of sodium) has been modified and adapted for clinical purposes by Esbach of Paris, Russell and West, and Apjohn. The process consists in estimating the quantity of nitrogen given off when a solution of urea is mixed with a hypo-bromite solution. This last named solution is very readily changed by keeping, and so must be made fresh. It is composed of 100 grammes of caustic soda, 250 c. c. of water, and 25 c. c. of bromine, all shaken up together. (Of course the soda solution can be kept and the bromine added in proper proportion when wanted, so as to be used fresh.) The following is the description of Apjohn's process (*Chemical News*, Jan. 22, 1875.) The instruments are such as may be found in any laboratory; they are: (1) A glass measuring tube of about a foot in length, drawn out at the end, which will be uppermost when the tube is used, like a Mohr's burette, and subdivided into 30 parts of equal capacity, the aggregate volume of which is 55 c. c. (2) A small wide mouthed gas bottle of about 60 c. c. capacity. (3) A short test-tube of about 10 c. c. capacity, of such a height that when introduced into the gas bottle it will stand within it in a slightly inclined position. (See Fig. 63.)

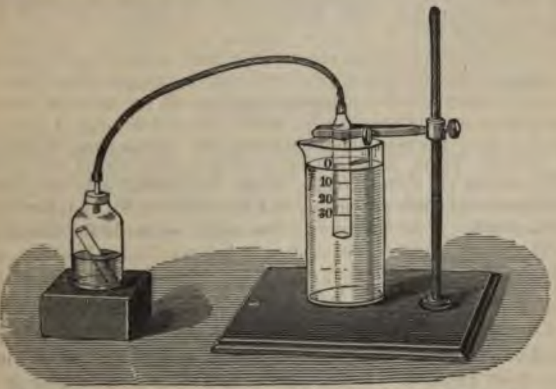

Fig. 63.—Apjohn's Apparatus for the estimation of Urea by the hypo-bromite of sodium solution.

The following are the arrangements for combining the apparatus and working an experiment: The graduated tube, held in a clamp attached to a retort stand, is depressed into a glass cylinder, nearly filled with water until the zero mark, which is near the upper end, exactly coincides with the surface of the water. 15 c. c. of the hypo-bromite solution having been poured into the flask, the test-tube containing the urine is introduced by means of forceps, care being taken that none of its contents shall spill into the hypo-bromite. The flask is now closed with a very accurately fitting India-rubber stopper, perforated with a hole in which is inserted a short piece of glass tubing open at both ends, and is then connected with the measuring tube by means of a piece of elastic tubing. It is now inclined so as to allow the urine to mix with the hypo-bromite. Effervescence at once commences, and as it proceeds the measuring tube is gradually raised so as to relieve the disengaged nitrogen from the hydrostatic pressure. The flask is shaken a few times, and when the reaction is completely over the apparatus is left for a few minutes until it has acquired the temperature of the room in which the experiment is performed. Another exact levelling of the measuring tube is made and the number of the division corresponding to the volume of the developed nitrogen is read off. 55 c. c. of the nitrogen correspond to 0.15 gramme of urea, so that a single division corresponds to .005 gramme of urea. If, therefore, we use 5 c. c. of urine, each measure of the nitrogen evolved will correspond to 0.1 per cent. of urea (or 0.44 grain per fluidounce).

Variations occur of course in the measured gas from the effect of changes in the temperature and barometric pressure, but the advocates of this method allege that these are inconsiderable in ordinary clinical work. Other nitrogenous principles are also included with the urea in the estimation by this method.

Of course the total urine passed must be known to estimate the total amount of urea.

COMPLAINTS BY PATIENTS REGARDING URINARY SYMPTOMS, &c.

Patients sometimes call attention to alterations in the appearance of their urine, of which it is important to be able to form some judgment. In the section on the "Obvious Characteristics of Urine" these have been considered (see p. 354).

Frequency and pain in micturition are often complained of by patients, either with or without the consciousness of some connection between these symptoms and other urinary disorders. The student of clinical medicine must never forget that these are important symptoms of surgical as well as medical diseases. Frequency of micturition may be due to stricture of the urethra, and it is very common in elderly men with enlarged prostate; in women it occurs in connection with uterine irritation, and with displacements of the womb. Increased frequency in micturition may be due simply to irritability of the urinary organs, but it is also often of value in calling attention to, or marking the date of, an increased secretion of urine, as in diabetes, and in certain forms of chronic renal disease. In the early stage of both of these, the patient may find that he has begun to get up at night to pass water, and although he may attribute this to his being thirsty and to his drinking more water than usual, the thirst and the increased urine may be due to the same cause. Frequency and pain in micturition often occur in nephritis, strangury, cystitis, and also from calculus in the kidney, ureter, or bladder. Scalding or pain in making water is often complained of in the febrile state; this is associated with the secretion of a highly acid and concentrated urine; it is also often due to gritty matter (gravel) in the urine, and to irritation of the urethra from gonorrhœa. In women it is not unfrequently due to small vascular growths at the orifice of the meatus urinarius, and occasionally to prolapsus of the urethra itself: these are very apt to escape attention, as their situation makes it a matter of much delicacy to examine the parts thoroughly. In male children the pain in micturition may be due to the irritation of a phymosis. Fissure of the anus, and other affections of the rectum, or disease in its neighborhood, often give rise to pain in passing water. These various causes may have to be considered and decided on by an ocular, or surgical, or instrumental examination of the meatus, the urethra, the bladder, the womb, or the rectum. Not unfrequently the presence of blood in the urine, its color and the manner of its coming, whether diffused in the urine or appearing as a few drops at the end of micturition, may assist the diagnosis. The presence of pus likewise in the urine, and the character and situation of the pain, are of great value in the study of such cases (see blood and pus, pp. 367 and 370). Any supposed cause of the painful attack, such as injuries, or special exertions from riding, jolting, &c., should be carefully inquired into. (See also the section on Paralysis of the Bladder, p. 178.)

CHAPTER XIV.

SYMPTOMS CONNECTED WITH THE MALE GENERATIVE ORGANS.

DISTURBANCES of the generative organs in the male come, for the most part, under the notice of surgeons; but complaints are sometimes made to physicians also, concerning impaired or disordered functions in these parts, and various nervous diseases arise from sexual excesses and abuses. The chief complaints met with in medical practice are connected with impotence, seminal discharges, and masturbation.

Impotence supervenes in the course of paralysis, and is very common in those forms of spinal paralysis which involve the bladder and rectum. Its occurrence in such cases is not due directly to sexual excesses, even although the paralysis may have been brought on in this way. Premature impotence, however, apart from other paralysis, is apt to arise at a comparatively early age in those who have erred in this respect. In locomotor ataxy there is sometimes an impairment of this function, although it has been alleged that this disease differs from other forms of spinal paralysis in this respect, and that there may be even an *excessive aptitude* for frequent indulgence. (Trousseau.) This, however, seems to have been overstated. Locomotor ataxy is well known to depend not unfrequently on sexual excesses in the case of men.

Various debilitating diseases, diabetes for example, are characterized by impotence as part, apparently, of the general debility. This is much less marked in some other exhausting diseases, and especially in phthisis.

Impotence is sometimes imagined or dreaded by patients without there being any good grounds for the opinion; and the idea sometimes seizes possession of the mind in such a form as to constitute a species of insanity. Prolonged brooding on such subjects, and the reading of quackish, or even of legitimate, medical dissertations on the consequences of masturbation, &c., are apt in certain minds to foster the delusion and to upset the calmness of reason. If the organs seem sound on examination, and if there continue to be indications of functional activity in them, we can usually reassure our patients. Points of importance in the character of the impotence, such as the following, have sometimes to be determined in view of the treatment: The absence of sexual desire: more or less anæsthesia of the glans penis: imperfection or weakness in the erection, from defect in the muscles concerned, or from other causes: premature emission.

Priapism (excessive or permanent erection) is an occasional symptom in spinal paralysis (myelitis especially), but no indications of special value can be drawn from its presence.

Masturbation is credited with the production of an untold number of ills, both bodily and mental. Although the practice is highly pernicious, it is probable that its influence has been overstated, especially in connection with the causation of insanity, although, no doubt, it sometimes tends to mental disorder (see p. 230). The possibility of excessive, or incontrollable masturbation, like excessive drunkenness, being due to the insane tendency of the patient, must be borne in mind. The frequent practice of masturbation, however, may produce various nervous diseases, just as we find that excessive sexual indulgence, even in the married state, may do so; and the great frequency of the opportunities presented to the masturbator in gratifying his desire, accounts probably for part of the special evils which arise in his case. Excess in venery which is often carried to an extreme by certain newly married people, and sometimes continued by them to an unreasonable extent, may give rise to palpitations, debility, and nervousness of various kinds: among the more serious forms of disorder, due to the various forms of excess, may be named spinal paralysis, locomotor ataxy, and convulsions. Mental disorder is supposed to arise at times from this cause (see p. 230).

It should be remembered, in presence of anomalous nervous symptoms, that even very young children sometimes practise masturbation, and this may arise from some mechanical irritation in the parts, or from less obvious causes (such as diabetes) connected with the organs.

Seminal discharges may likewise be greatly exaggerated in importance by the pernicious influence of quack literature, or the reading of other medical books. The terrors held over their patients by quacks have likewise a powerful influence on many persons. A certain frequency of these emissions is natural to young men who lead a chaste life, and their frequency is often increased by studious or sedentary habits, and the attendant dyspepsia and constipation so common in such persons. A course of prurient reading also favors this unnatural frequency. When the emissions occur every night, or twice or thrice a week, the condition is certainly unnatural, although not necessarily alarming, and this is the more certain if the discharges occur without the patient being aware of their coming away, or if they occur during the day, or without any previous erection. Patients sometimes complain very much of this symptom, and allege the frequent passing of semen in their urine. This does occur at times, but the milkiness or turbidity complained of is not unfrequently due merely to phosphatic deposits occurring in the alkaline urine within the bladder. Chemical and microscopic tests can set such doubts at rest. Another form of discharge complained of consists of a little clear glairy fluid, like white of egg, frequently or constantly exuding from the urethra. This is due to prostatic or some other than the seminal secretion, and has not much significance, although it is increased by the same influences which favor frequent seminal emissions. When from the account given, or from the frequent or habitual presence of spermatozoa in the urine, we are satisfied of the existence of a morbid condition, we must inquire whether any unnatural excitation of the parts has been caused by masturbation, a practice which patients do not always readily confess. The general health and habits, the state of the stomach and bowels, and the use of stimulating food or drink late at night must be inquired into.

This condition is often found to be associated with a most distressed state of mind, want of energy, depression of spirits, with perhaps actual weakness and incapacity for work; the patients seem often to foster the idea of their dreadful condition, and refuse all hope and consolation. This state is often associated with other abnormalities, particularly frequent alkalinity of the urine, and the deposit of oxalates, with a high specific gravity of the urine.

CHAPTER XV.

DISORDERS OF THE FEMALE ORGANS, AND THEIR RELATIONS TO THE GENERAL HEALTH.[1]

MENSTRUATION AND ITS DISORDERS.

MODE of conducting the inquiries.—Students often experience considerable difficulty at first, in conducting inquiries on these subjects. What are the points regarding which information is to be elicited? How are the questions to be put? The inquiry can always be conducted with such refinement as will not offend any proper delicacy of feeling; whilst on the other hand an unfavorable impression may readily be conveyed to the mind of the patient by the form or mode of putting a question. Coarseness or impertinence have often been ascribed to medical men, simply from want of tact, discretion, or personal refinement in this respect.

In many cases a few general questions are all that is necessary. In hospital practice, where the cases are fully recorded, inquiries should always be made as to these functions; but in private practice it is well to abstain unless there is a clear necessity. When the patients are young, inquiries should, when possible, be made through the parents; at all events the subject should be introduced through them.

It is well to lead up to the subject, or introduce it with special bearing regarding the symptoms complained of. Thus one question may introduce another. Having asked if the bowels are "regular," there may next come, "And are you regular in your own health?" "Not too often or too much at a time?" Or if some special pain or derangement of function is complained of, the subject may be introduced by asking, "Do you suffer in this way more at the times you are unwell than between times?"—and then follow the above questions. It is well even at times to offer some such explanation as "symptoms such as you have are often dependent upon derangement of your own health." Women do not understand the term "menstruation." They speak of being "unwell"—of being "regular." It is also known by some as the "periods," or the "courses." They will also say, "My own has left me."

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[1] The following writers may be referred to for further information on the subjects dealt with in this chapter: West, Barnes, Graily Hewitt, Matthews Duncan, and Sir James Simpson. Montgomery on the Symptoms and Signs of Pregnancy, Bernutz and Goupil's Clinical Memoirs, translated by the New Sydenham Society, and Lectures by Hildebrandt, Olshausen, and Gusserow, in the German Clinical Lectures issued by the same Society (vols. lxvi. and lxxi.), may be consulted with advantage. The subject must also be considered in connection with the Physical Examination of the Abdomen, see Chapter xvi., Part 3, and some of the works referred to there.

Normal Menstruation.—The functional activity of the female generative organs is normally manifested by the periodic discharge of blood, which constitutes what is termed menstruation. The points regarding which inquiry is to be made, or in other words, the evidence by which the healthy performance of the function is to be determined, are: (1) The regularity of the return; (2) the duration of the period; (3) the quantity of the discharge; and (4) the amount of local or general disturbance which accompanies it. There is a normal standard which is taken as the guide, but each case must also be judged by the individual habit.

(1) The interval between the first day of menstruation and its reappearance at the next period is generally reckoned as twenty-eight days or four weeks, but certain differences exist. Some women "alter" by the calandar rather than the lunar month; some regularly every three weeks, whilst others exceed the four: and even a degree of irregularity may be natural to the individual and consistent with good health. (2) The duration of the discharge likewise varies, from two, or even one day, to eight days. (3) Some lose but little blood, others a considerable quantity. (4) Some suffer no inconvenience, whilst others have considerable local pain. The individual habit, therefore, must always be ascertained and taken as the criterion of healthy function rather than a general standard. What in one person may be normal may in another be evidence of excess or defect.

It is not sufficient to receive a simple affirmative reply to the question, "Are you quite regular?" Many women will so answer when afterwards they will be found to have excess either in time or in quantity, or in both. It is necessary, therefore, to follow up by "Not oftener than you used to be, not more at a time than you always had?"

Menstruation is generally accompanied with more or less malaise, and a degree of local discomfort or even pain. With every derangement of function an increase of suffering is present; but the relative value of pain will be discussed in a future paragraph. The mucous membrane and glands of the genital tract secrete a fluid sufficient to keep the opposing surfaces moist, but under ordinary circumstances it is not manifest externally. In unhealthy conditions it escapes externally, constituting what is termed leucorrhœa or popularly "the whites." A physiological degree of leucorrhœa is often present just before or after menstruation, and must not be confounded with the pathological state when persistent throughout.

Various derangements of menstruation have received distinct terms in medical nosology. Its non-appearance at the usual age, or its suppression after its establishment, is known as AMENORRHŒA, when accompanied by excessive pain it is termed DYSMENORRHŒA; when in excess, MENORRHAGIA. It cannot, however, be too firmly impressed upon the mind that these terms represent symptoms only, and not actual diseases; and however useful for the purpose of study or description the divisions may be, they do not represent any actual state which will determine treatment. Amenorrhœa may in one case be the result of bad health, and in another may be consistent with a robust constitution. Menstruation may regularly recur, and yet the constitution may be steadily becoming undermined from the strain thrown upon it in the developmental processes which are taking place. It must always be remembered that menstruation is but part of the general process of the development of reproductive life, and that the latter is not completed when the menstrual discharge has once regularly been established, but continues for some years; in fact it may be considered incomplete in many cases until the twenty-second year. Whatever, therefore, the nature of the prominent symptom may be, the opinion to be formed and the treatment will be determined less by that symptom, than by the constitutional character or habit of body of the patient, and the nature of the disturbance of the general functions.

Primitive Amenorrhœa (Emansio mensium), where the flow has never taken place. The inquiries should be made to elucidate the following points:—

(1) The age and general development. In this country menstruation first shows itself from the thirteenth to the fif-

teenth year. But age is not a sure criterion, the general development of the body must be associated with it. (2) The previous history: a severe illness about the age of puberty may retard menstruation. (3) Is the anemorrhœa part of impaired health? (anæmia, chlorosis, the tubercular diathesis). (4) The configuration being womanly, and the health otherwise good, is there defective development of the uterus, or defective formation of the generative organs? (absence of ovaries, or uterus, or vagina). The diagnosis in the latter case can only be absolutely made by a physical examination—a recourse, however, only to be had under very special circumstances.

Internal evidence of functional activity, without discharge, is sometimes present in the periodical recurrence of lumbar and pelvic pains, malaise, headaches—symptoms known as the *menstrual molimen*. At times epistaxis or other hemorrhages may occur. The regular periodicity is the all-important character of such symptoms. They are evidence of ovarian activity, and the presence of these organs is all that can be inferred from them. The absence of such symptoms, however, is no evidence of want of these organs. The occurrence of these symptoms with increasing severity, and the appearance of a tumor rising out of the pelvis, is diagnostic of retained secretion (imperforate hymen or occlusion of os, &c.). In all cases where the menstrual molimen has occurred, the abdomen should be examined for such a tumor.

Menstruation having appeared, is the health suffering from the strain of the developmental process?—Amenorrhœa usually causes much anxiety on the part of parents for the health of their daughters, but when once menstruation has occurred it is thought the danger is passed. We have already observed, however, that the strain of reproductive development continues for some years after this event, and the health may suffer from this cause, especially under the influence of bodily or mental overwork. The symptoms are very varied, and often indefinite, and may affect the nervous or digestive systems, or the blood-making function. The important point is to determine the relationship between the constitutional suffering and the performance of the uterine function. In one class the faulty nature of the latter is the effect of the former, as when amenorrhœa occurs in the course of phthisis or from sedentary habits. There is another class, however, where the menstrual tax is the cause, the general suffering the effect. In the latter class inquiries will generally elicit that at first the lassitude and inaptitude for work, change of disposition and headaches, or the derangements of the alimentary canal, or the localized pains, were part of the menstrual molimen, but that by the accumulation of effects they have become constant. In the first class, although the deranged uterine function may be the immediate cause for seeking advice, it can generally be found that failure of the general health in some respects was antecedent, although unnoticed at the time; or, at all events there is not the same close relationship in the order of events. To arrive at a just estimate of a case it is thus highly important to determine the order or sequence of the symptoms. Anæmia may be caused by uterine derangement, or the anæmia may be the cause of the latter. In many cases it may be very difficult to determine the relation, but success in treatment will none the less depend upon the accuracy of the diagnosis.

The health may thus suffer with perfect regularity in the performance of menstruation. Frequently, however, this function is also deranged. The character of the derangement depends to a large extent upon the constitutional temperament. In the relaxed or strumous habit, there is generally excess in frequency or amount, with copious leucorrhœa; in others, the tendency is to scanty or irregular menstruation; and in the highly nervous temperament, or where there is a hereditary history of gout, the ovarian pains, spinal irritation, or cerebral suffering predominate.

Suppression of Menstruation or Secondary Amenorrhœa.—The inquiries should be guided by the following list of causes:—

(1) Pregnancy (see signs of pregnancy, p. 412.) (2) Influences affecting the system at a catamenial period; (cold, mental emotions, and exanthematous diseases.) (3) Constitutional causes; (after fevers, sedentary and confined occupations, change of residence, long continued mental anxiety, anæmia, chlorosis, continued drain on the system, tuberculosis.) (4) Local causes; (pelvic inflammations, stricture of the os, imperfect involution after abortions or delivery at full time; more rarely diseases of the ovaries and displacements of the uterus.)

Menorrhagia is excess of the menstrual flow. Hemorrhage from the uterus, not menstrual, is termed "Metrorrhagia;" but it is difficult at times to determine whether the discharge is of the one nature or the other. The distinction is nevertheless important. The first point to determine is the character of the excess, compared with the ordinary standard and the individual habit before referred to. The excess may be in quantity, or in duration, or in frequency of return, or in any two or all of these combined. Whatever the change, maintenance of regular periodicity, both in duration and the return, favors the idea of a truly menstrual nature, as distinguished from hemorrhage. Excess in duration is easily noted, but patients are sometimes not so observant as to determine quantity. If clots are discharged in any quantity or size it is evidence of excess in amount, but small shreddy clots discharged during micturition are common. The question may also be put, "Do you find you have to use more napkins than formerly?" In metrorrhagia the discharge may take the form of flooding, or considerable gushes, and in female parlance it may be described as "finding a napkin frequently of very little use."

The special cause of the menorrhagia must be determined by the previous history, the general constitutional condition, and the local examination. (1) The previous history. Menorrhagia is frequent after abortions, or on return of the catamenia after nursing, especially when lactation has been prolonged. It is common shortly after marriage; at times menstruation will then be suppressed for one or two periods and return in excess—the first time being supposed to be a miscarriage. Change of residence or mode of life is at times the cause. Profuse menstruation sometimes follows acute fevers and pelvic inflammatory affections. (2) The general condition. In young girls, especially those of the strumous, or so-called phlegmatic temperament, menorrhagia is often present. Also at all periods of life, from a sluggish abdomen; constipation, hepatic derangement, loaded urine, a full plethoric habit of body, or rheumatic or gouty constitutions are frequently associated with the affection. Altered conditions of the blood, associated with Bright's disease, purpura, and the like, give rise to menorrhagia; but in simple anæmia it was necessary to determine by the history whether the anæmia is the cause or the effect. (3) Local examination. It is often a question whether in a given case a local examination is necessary or not. If the periodicity is well maintained, a sufficient constitutional cause having been found, and no other marked symptom of uterine disease existing, then it is not necessary at first. But if treatment has already failed, if the periodicity is not well observed, and if there has been marked flooding or metrorrhagia rather than menorrhagia, and if any other symptoms suggestive of organic changes or of displacement are present, then an examination should be insisted upon.

Dysmenorrhœa.—A certain degree of pain and discomfort is felt during a menstrual period by the majority of women, but at times it becomes so severe as to compel them to seek advice. Cases of this description are usually divided, in systematic works, into congestive, neuralgic, and mechanical dysmenorrhœa. The division is not a very practical one, for in many cases all the forms are more or less combined. There are also some authors who view all cases as primarily mechanical in origin. Into the discussion of this subject we cannot here enter, but must view it from the purely clinical aspect.

The first question is, has the dysmenorrhœa existed from the earliest years of menstruation? If so, it is often associated with an imperfect development of the uterus. In such, the flow is scanty, irregular in recurrence, or coming and going during the period. If regular, the quantity natural, and the pain present from the first, the presumption is that there is some defect in formation (narrow os, with small cervix) or congenital malposition; and the further evidence of obstruction will also be present. In this class of cases, it must, however, be remembered that menstruation may for two or three years be comparatively easy, but when the quantity is increased, or the character is changed from constitutional causes, or the sensibility of the nervous system increases by the accumulation of effects, the dysmenorrhœa may come on later and more gradually. The fact, therefore, of its non-existence in the earlier years does not exclude a congenital mechanical cause of the dysmenorrhœa.

The severity of the pain differs as to time: it may be felt before the discharge, or only with its appearance; it may last for a few hours only, or be felt during the whole period; it may be steady and continuous, or paroxysmal and remitting. It varies in its position, central in the uterus, or general in the pelvis, or lateral in one or both ovaries. It may be a hot throbbing pain, or acute and lancinating, and running in the course of certain nerves. It is nearly always reflected to the back, and often to the head or under a breast, limited there to a small spot. These characters must be noted and taken as factors in arriving at an opinion.

When the pain is chiefly due to obstruction to the flow, it will probably be paroxysmal in character, each attack being followed by a flow—and at first the discharge is dark in color, sometimes black and tarry. The obstruction, however, is not necessarily a constriction of the canal. It may be from dysmenorrhœal casts—the mucous membrane being shed in pieces—or it may arise in a purely congestive form, and be owing to the rapid escape of the blood, permitting partial coagulation. In such a form it will most likely last only during the first day. This latter character is more or less common to the purely congestive forms, the discharge giving relief to the vessels, but it will be variable in degree according to the amount of the congestion, the permanency of its cause, and the amount of the discharge. By some authors the arrest of the pain after the first day is regarded as evidence of a flexion in the cervix,—the congestion of the organ producing erection of the uterus, and straightening of the canal.

The localization of the pain to one or both iliac regions or to one or more nerves, together with disturbance of the nervous system generally, will determine how far the case is one of purely neuralgic character. But it must always be borne in mind that neuralgias are frequently due to mechanical causes, or have their origin in disease of the cervix. They may likewise have their origin in general constitutional conditions, specially hereditary gout.

By vaginal examination the existence of a mechanical cause of dysmenorrhœa is recognized by narrowness of the cervical canal—usually associated with a small, or elongated, or conical cervix—and also when marked flexions of the uterus are detected.

"THE CHANGE OF LIFE:" THE CLIMACTERIC PERIOD, THE MENOPAUSE. By these terms are denoted the end of reproductive life in the female, as indicated by the cessation of menstruation. This period is marked by a predisposition to both local and general derangements of health. It occurs between the fortieth and fiftieth years.

Local Derangements.—The manner of the cessation of menstruation varies. It may cease suddenly or gradually—the intervals becoming longer and more irregular, and the quantity variable. This period of irregularity is spoken of as "the dodging time." Frequently the change is indicated by excess of menstruation, both in quantity and frequency. The menorrhagia of this period should not be overlooked, but carefully investigated, especially if continuing past the ordinary age. Hemorrhage returning after a lengthened interval, and presenting no definite periodicity, is always suspicious and calls for an examination.

General Derangements.—The nervous, vascular, and digestive systems frequently suffer. One of the most frequent complaints consists in flushings, chiefly of the head and face, and sometimes felt over the whole body. It is associated with a hot, bursting feeling in the skin, and is often relieved by perspiration. A dryness of the skin, or want of ordinary perspiration, is frequently associated with the flushings. A peculiar headache affecting the occipital region, and extending to the neck, is often experienced. It has long been recognized that there is at this age a special predisposition to mental derangements. Rheumatic and gouty affections may also manifest themselves, although previously absent. The digestive system tends to become sluggish and impaired.

CLINICAL VALUE OF SPECIAL PELVIC SYMPTOMS.

Leucorrhœa.—We have already referred to the physiological variety of "the whites." It is common either before or after menstruation, and lasts but a limited time. A considerable amount of "the whites" is met with at times during pregnancy.

In young girls leucorrhœa is common, and is often regarded as the cause of the weakness. It is properly the effect, and may be met with in debilitated constitutions, especially the strumous and phthisical. The absence of any other uterine symptom except amenorrhœa, or scanty and irregular secretion, will point to the truly constitutional nature. Any bad hygienic influences, and certain occupations, such as the use of the sewing machine, may lead to this form of the affection.

Leucorrhœa is an almost constant attendant of all uterine affections, but usually other symptoms are associated therewith. In such cases a careful examination should be made when possible, before treating in routine fashion the prominent symptom.

The secretion may come from the uterus, the vagina, or from both. In the former case it may be seen by means of the speculum escaping from the os, clear and glairy, like the white of egg, becoming thick and opaque in the vagina. Curdy pieces or thick tenacious mucus generally indicate that the cervix is the seat of origin. The microscope will also detect the source by the character of the epithelial cells

—round or columnar from the uterine cavity, and tesselated from the vagina. The discharge may be purulent in character, but no special inference can be derived from this condition. The diagnosis must be based on other considerations. A mucous discharge may be present, and even abundant, without the patient being conscious of it, either from inattention or from its escaping only during micturition.

Children at all ages are liable to a form of leucorrhœa, which however is situated in the vulva only. It is often very obstinate, and is dependent ûpon a depraved constitutional state, associated at times with local causes, such as want of cleanliness, or the irritation of diarrhœa or worms.

Watery discharges. Associated with leucorrhœa or occurring alone, the discharge is often watery in character, sometimes greenish in color, at others pink or tinged with blood. If there is any cause for suspecting pregnancy, it may be the rare affection termed *hydrorrhœa gravidarum*, or a symptom of the cystic (hydatidiform) degeneration of the ovum. A greenish watery discharge sometimes follows parturition, and is associated with imperfect involution of the uterus. Met with under other circumstances, and specially when pink or frequently bloody, the usual cause is malignant disease. In all cases the odor is sufficient to distinguish between a watery discharge and an involuntary escape of the urine. Several cases are on record where watery discharges formed the sole symptom of a uterine polypus, but these are more commonly associated with hemorrhages.

Pain.—The significance of this symptom, apart from the revelations of a local examination, must be determined by the character, the exact seat, and the time of recurrence or exacerbation, with the apparent cause.

(1) The character is very variable, dull and constant, sharp, shooting, hot, throbbing, &c. One term frequently used is "down bearing;" as used in general it is utterly indefinite. It is employed for the feeling of fulness or distension; or it may be simply weight, or the sensation that something is trying to press out at the "front passage." It is met with not only in uterine affections, but also when the bladder alone is irritable, or it may arise from hemorrhoids.

(2) The exact seat of the pain must be noted—whether limited to a spot or diffused over a limited area. Thus pain is often described as in the side—this may be near the crest of the ilium or in the inguinal region. Again, a pain in the latter part may be general or indefinite, as when due to dis-

ease of the cervix—but when arising from the ovary, the spot can be exactly localized and covered with two fingers. By careful localization affections of special nerves can be made out. The pain of cancer of the uterus is frequently localized, immediately behind the pubes, gnawing or grinding in character, marked by nocturnal exacerbations. Pain with a marked periodic character of this description may warrant the assumption of malignant disease of the fundus (*vide* Sir J. Y. Simpson's works); at the same time periodic nocturnal pains are sometimes present in acute pelvic inflammations. Dorsal, lumbar, and sacral pains have no special pathognomonic significance—they are common to all pelvic affections.

(3) An important question to determine is whether pain is menstrual in origin. If recurring only with the catamenia, lasting for a short time after, and disappearing till the next period, the question is simple enough. But a pain may be constant and yet menstrual. In such a case the history will show that at first the pain occurred only with menstruation, but gradually increasing (by accumulation of effects) it has become permanent, though still subject to exacerbations at a monthly period.

(4) Lastly, light may be thrown on the nature of the pain by the conditions which set it up, or cause relief or aggravation. Is it affected by position? Pains of an inflammatory nature, or due to malposition, are relieved by rest and aggravated by the erect position. Neuralgic pains are not so influenced. The weary backache, induced by exercise or fatigue, and relieved by rest, is often due to the accumulated effect of the menstrual pain. Again, pain occurring when one position is assumed for a time, but relieved by a change of position, or by walking about, would point to blood stasis—being due to temporary distension of the vessels of the part. A pain which is easy while walking but comes on while sitting is often of this nature.

Is the pain affected by movement? An inflammatory condition is always so. If slight it may be elicited only by a jolt or sudden movement. Neuralgic pains are not so influenced. If muscular, it may only arise on movement of certain muscles. It must be remembered that muscular action produces pressure, and may elicit a neighboring inflammatory pain, as in the action of the psoas muscle in the various positions of the leg.

The pain may be associated with the act of micturition or defecation. In pelvic peritonitis acute pain on micturition is frequent, but there is other pain as well. If closely limited in its relation, occurring with the act and lasting for some time after, the cause is most likely to be in the bladder or urethra (painful caruncle). Intermitting pains of short duration, simulating the pains of labor, are met with where something is being expelled from the uterus—such as a blood clot, retained mucous secretion, or dysmenorrhœal membrane.

THE CONSTITUTIONAL, OR REMOTE DERANGEMENTS DUE TO PELVIC AFFECTIONS.—From the endless variety of these it is evident that only a few can be here enumerated, such as every student should be aware of.

1. The digestive system.—Want of appetite, sickness, and nausea are frequent. The uterine origin is indicated if the sickness occurs on assuming the erect posture in the morning, or with exacerbations at the menstrual period, or if the general symptoms show remissions with the pelvic symptoms. Constipation is more frequently a cause or source of aggravation of pelvic disorder than the effect, except where pain on defecation incites the patient to restrain the action. The same may be said of sluggishness of the liver, associated with high-colored or sedimentary urine.

2. The nervous and vascular systems.—A pain limited to a spot under the breast is a frequent complaint; also pains in the back in the lumbar region, or even extending between the shoulders—often sensitive to the touch. Tic may likewise have a uterine origin, but in such cases it will frequently have a clear association with the catamenial period; it occurs also with pregnancy. The headaches are not always definite in character, they may be frontal, or occipital, or at the vertex. At the change of life the occiput is the more general seat (see Change of Life, p. 406). Through the nervous system, the heart and bloodvessels are frequently affected—palpitation, flushings, and the like. A very common effect, due to pelvic derangement, is coldness of the extremities, which again reacts in aggravating the pelvic pains. Epileptic attacks may occur regularly with the menstrual periods. Spinal irritation has sometimes a uterine origin, as also hysteria and other mental derangements.

3. As a very special influence due to pelvic origin must be noted the faintings and constant feelings of exhaustion, or loss of energy, experienced by many suffering from even slight uterine ailments. In some patients the influence exerted through the pelvic nerves is very marked. Many patients are exhausted and feel faint after each time the

bowels are moved. An injection will often cause great prostration. In the same manner inflammation of the cervix, though causing no pain but only a constant discharge, will frequently produce great lassitude and ready fatigue. Hæmorrhoids frequently have a similar effect. Retro-version and ante-version of the uterus act in a similar manner, even when there is no local tenderness. The patient's expression frequently is that all energy or strength seems to go as soon as she gets up and begins to move about. Tonics are useless in such cases, so long as the local condition is unalleviated. The special pelvic symptoms may be very slight, at other times they are severe and well marked. The grouping of symptoms in such cases generally is as follows: Some pelvic suffering, gradually loss of strength and appetite, ready exhaustion, with sickness on assuming the erect position, and steady loss of flesh from inability to take nourishment.

The determination of the relation between pelvic derangements and remote or constitutional suffering.—Affections of the pelvic organs are known to produce marked disturbances in the function of remote organs; and again, derangements of other parts frequently produce changes in the uterine function. It is therefore highly important to decide the relationship. The question has been frequently referred to in previous sections. In many cases it is evident enough. Thus, amenorrhœa in a phthisical patient may be regarded as a common effect, not the cause, of the general affection. When not so clear, the order and succession of the symptoms must be carefully investigated.

When derangements of the stomach are of pelvic origin, there are some special characters which may indicate the association—as when they partake of the characters met with in pregnancy—as sickness, chiefly on assuming the erect position in the morning (when dependent upon disease of the cervix this is often noted); or if manifesting recurrence or exacerbations at menstrual periods; or if coming and going with special pelvic symptoms. The same holds good with many neuralgic affections. Frequently, however, it may be found that whilst due to pelvic irritation the derangement has become permanent and persists, whilst the exciting cause is intermittent, or may even have passed off altogether. The "weary backache" is often of this nature due to menstrual irritation, yet persistent. The early history, however, will reveal the true nature.

THE DIAGNOSIS OF PREGNANCY.

Pregnancy, it must be remembered, may occur under circumstances where it might not be expected, as in very young girls, or in women past the ordinary age of child-bearing. Pregnancy has been recorded in this country at the thirteenth year, and as late as the fifty-fourth. Women who have stopped having children for many years may again begin to bear when nearing the change of life; or a woman may be pregnant for the first time after many years of married life. It is very common for mothers who are nursing to be again pregnant without menstruating, or even being aware of it. Again, a patient may have had amenorrhœa for many months, or have always been very irregular, and yet become pregnant. Caution, therefore, is ever needful, and more especially in the use of the uterine sound as a means of diagnosis.

In the latter half of pregnancy, whan the uterine tumor is perceptible above the pubes, when either the fœtal movements may be felt, or the auscultatory signs can be heard, and when, in first pregnancies, the mammary signs are distinct, there can be little difficulty in the diagnosis; errors are then made by careless examination. The suppression of menstruation with the occurrence of an abdominal tumor should always necessitate, in the medical practitioner's mind, the exclusion of pregnancy, by the positive evidence of a thorough examination.

In the earlier months the diagnosis is more difficult, and in doubtful cases it should be deferred. The suspicion, though felt, should only be expressed on positive evidence. The sudden arrest of menstruation, without apparent cause, in a woman who has always been previously regular—associated with morning sickness, and shooting pains or fulness in the breasts—is often quite sufficient presumptive evidence of pregnancy.

Suppression of the Catamenia, although one of the first symptoms, is equivocal in value. It merely opens up the question. The suppression may be due to other causes. It is possible also for a woman to menstruate once or twice after conception: in such cases the amount of discharge is markedly diminished. A discharge of blood may also occur during pregnancy, and be repeated at intervals, without being menstrual in its nature.

Morning sickness alone is of little value, it is variable in its occurrence as to time and duration, is often absent, and may arise from other conditions.

Changes in the Mammæ. The breasts early sympathize with the condition of the uterus, but they do so in other conditions as well as in pregnancy. They increase in size, and become sensitive with shooting pains. It is in first pregnancies that the areolar signs are of most value, but even then they vary greatly in different individuals; and a deepening of the color, with slight prominence of the nipple, may arise from other conditions of the generative organs. It is in the third month that the increased turgescence begins to alter the characters. The nipple becomes more prominent, the areola increases in size, and its color deepens, whilst the follicles on its surface become more prominent. As pregnancy advances these changes are more pronounced, and the surface assumes a moistened appearance. After the fifth month there may appear what has been described by Montgomery as the secondary areola, immediately around the other, faint in degree, as if the color had been washed out.

The abdominal tumor. The abdomen is often perceptibly enlarged before the uterine tumor can be felt externally. After the twelfth week, sometimes earlier, the uterus can be defined above the pubes, by the sixteenth it should reach midway between the pubes and umbilicus, and by the twentieth be as high as the latter point. It is not always central in position, most frequently there is an inclination to the right. Its uniform spheroidal shape, and moderately firm elastic resistance, are of service in distinguishing between it and other tumors, differing in these respects from the hard fibroid, or more distinctly fluctuating ovarian cyst. Should the consistence change under manipulation, the tumor becoming firmer, it is almost certain to be uterine, though not necessarily pregnancy. At times the uterus may be so lax before the seventh month that there may be some difficulty in defining the tumor, especially if the abdomen be full or tense. Mistakes are frequently made from this cause.

Vaginal examination. The cervix is at first displaced downwards, afterwards somewhat backwards, the enlarged body being felt in front (anteversion). At times the displacement of the body is backwards. The cervix from an early period undergoes softening of its tissues, beginning in the mucous coat, and gradually invading all the tissues, till towards the end of pregnancy the cervix seems shortened. The vaginal portion is really shorter, from the uterus being held high up, but the cervical canal is not diminished in length till a few days before parturition. In pluriparæ the os in the later months is sufficiently patent to admit the point of the finger. The vaginal mucous membrane early assumes a deep violet hue.

Fœtal movements. By the mother these are usually felt, for the first time, from the sixteenth to the eighteenth week; this is spoken of as "quickening." Somewhat later they may be felt by the examining hand, and about the same time *ballotement* may also be made out. Women who are not pregnant, but have a strong desire to have children, or are suffering from mental ailments, frequently imagine that they feel the movements of a child.

Auscultatory signs. The uterine souffle may be heard earlier than the fœtal heart's sounds, but it is not certainly diagnostic of pregnancy; it is heard at times in fibroid tumors. The usual time for the pulsations of the heart is the eighteenth week, but they have been detected earlier. In listening for them before the seventh month, a point in the mesial line somewhere between the pubes and umbilicus, but nearer the former, is where the sounds are most likely to be heard. After the seventh month they will be found most frequently about the middle point in a line from the umbilicus to the superior spine of the ilium on the right side or the left. But the place must necessarily vary with the position of the child. The rate varies from 130 to 160, and the beats are of course not synchronous with the maternal pulse.

PELVIC EXAMINATIONS.

Indications for a physical examination of the pelvic organs.—It may be laid down as a general principle, in the words of Dr. Barnes, "That when constitutional or remote effects are present, associated with marked symptoms of derangement of function of the pelvic organs, the necessity of exploring the physical state of these is as clear, as is that of examining the state of the heart or lungs, when these organs perform their functions with distress, and the whole system suffers." At the same time, for obvious reasons, such a course is only to be adopted under special necessities. In many cases a diagnosis can be arrived at without this. It is unnecessary to subject a patient to this ordeal when the local derangements are clearly but part of a general constitutional suffering, especially when the local symptoms are but functional, and *are unassociated with local distress.* To this class belong many cases of amenorrhœa and menorrhagia. (For rules as to examination in the latter case see p. 404.) In amenorrhœa marked periodic local suffering calls for an external examination at least, in order to detect any tumor from retention of the menstrual fluid.

It is the nature and amount of the local suffering that must determine the necessity for an examination, together with the order or succession of the symptoms. There are cases, however, where from the presence of an apparently sufficient constitutional cause, and the local symptoms being slight in degree, an error in diagnosis may be made from want of an examination. Thus, after delivery an imperfect convalescence may have occurred; much weakness and faintings are complained of; the patient is nursing, and to this cause the debility is assigned. If under such circumstances, any, though slight, local symptoms are present, such as pain, or continued discharge, a careful vaginal examination should be made, and a slight parametritis or sub-involution may be detected. At the change of life also, local affections, which demand attention, are liable to be overlooked, from the tendency to regard the uterine derangement as due simply to "the change." If the local affections are severe, or persistent, a vaginal examination should always be made.

Mode of conducting pelvic examinations.—The patient should lie upon her left side, with her shoulders low, and thrown as much forward on the front of the chest as possible, and her knees drawn up. The forefinger of the right hand, well oiled, is to be introduced between the labia from behind forwards; the opening of the vagina being reached, the finger should be gently pressed into the canal following its direction. Note in this procedure the sensitiveness of the parts, and the consistence of the tissues. The perineal and vaginal constrictors will contract slightly, but will soon again relax, when the finger can be introduced to the full extent. The following points must then be noted:—

1. The presence of tenderness or pain upon pressure by the finger, care being taken to note the exact situation of the tenderness.

2. The position and the direction of the cervix.—The vaginal portion of this can always be reached. The os should be felt at the end of the finger, and the direction ot the cervix should be downwards and backwards. To esti-

mate its position in the pelvis, there are two fixed points for reference. First, the symphysis pubis; the point of the finger resting against the cervix in the anterior cul-de-sac, the part of the finger which rests against the lower margin of the bones indicates the distance. This point should be slightly beyond the second joint. If the os is beyond reach, or nearer the os pubis than above indicated, there is some displacement. The posterior cul-de-sac should only be reached by pressing back the perineum. The second point of reference is the coccyx—feeling for it externally, the distance of it from the os should be noted. The latter is frequently placed too high in the diagrams in our text books. In those who have not borne children it is seldom more than an inch above the coccyx, but in those who have had a family it is often within half an inch, and frequently lies anterior to the coccyx.

3. The shape and consistence of the cervix with the degree of patency of the os.

4. The mobility of the cervix.—Experience is required to estimate this correctly; in general it may be stated that it should be mobile to the extent of a quarter of an inch in any direction. Fixedness of the uterus is an important diagnostic point.

5. The feeling of resistance of the vaginal walls.—Apart from the cervix there should be no fulness or resistance. In the normal position a portion of the body of the uterus may be felt through the superior wall. Feces in the rectum will give resistance in the posterior. Otherwise any degree of fulness on one side, as compared with the other, or of hardness, must be noted.

6. The examination is not complete without combining the use of both hands, the one internal, the other external, pressing downwards into the pelvis from above the pubes. In this manner the size and position of the uterus or the size and relations of a tumor may be determined.

7. By the sound and speculum we complete the examination (see pp. 420, 422). The sound enables us to determine the direction in which the uterus lies and the length of its cavity. It enables us also to a certain extent to decide as to the relation which exists between the uterus and any pelvic or abdominal tumors. It should never be used if there is a suspicion of pregnancy, and only by experienced hands if there is marked tenderness either in or near the uterus.

Much mischief may be done by the incautious use of this instrument.

By the speculum we bring the cervix, os, and vagina under the observation of the eye. Experience diminishes to a large extent the necessity for its use in many cases. It need not be employed by any if the cervix feels normal in shape and consistence, and if there is no leucorrhœa. When discharge is present it may be necessary to employ it, to decide the seat of origin—whether uterine or not. It should not be employed except by the experienced in the case of unmarried women.

8. Examination per rectum is often of advantage, but requires experience. It may be employed when examination per vaginam is objectionable. By this method the finger can reach higher posteriorly; and it is believed by some to give increased facilities in determining the condition of the ovaries. The uterus, when retroverted, may also by this means be brought more readily under the command of combined internal and external manipulation, to determine its size.

Diagnostic Value of Evidence obtained by a Vaginal Examination:—

1. *Increased sensitiveness or pain on pressure.*—(*a.*) At the orifice of the vagina. The following conditions may give rise to this symptom: Small, highly vascular and sensitive points in the mucous membrane, or a similar general condition around the orifice; inflammation of the vagina; fissure of the vaginal orifice. These conditions are associated with a strongly spasmodic condition of the sphincter vaginæ, and constitute what has been termed "vaginismus." The carunculæ myrtiformes are sometimes highly sensitive. Lastly, the conditions may arise from painful caruncle at the orifice of the urethra, or from the presence of piles. (*b.*) Tenderness in the region of the bladder, when that organ is inflamed. (*c.*) Tenderness on pressure or movement of the cervix—endocervicitis, or endometritis; also, when the ovary is inflamed, from movement or pressure being conveyed to it. If pelvic peritonitis is present the cervix is often fixed, but pressure will elicit pain. (*d.*) In pelvic peritonitis, or cellulitis, pressure not directed on the uterus, that is, to one side or the other, will cause pain—whilst, if the uterus alone is sensitive, there will be no tenderness if the uterus be not moved. If the ovary is affected, pain is elicited by pressure in the direction of the organ; the further diagnosis is de-

pendent on the degree of fulness or the form of the swelling. (*e.*) The presence of a limited localized inflammation of the connective tissue around the cervix (parametritis proper) may often be ascertained by gentle pressure round about the cervix, so as not to cause movements of that organ. This will elicit pain; whereas if the pressure is made more general, so as to move the cervix, the seat of the pain may be supposed to be in it, when it is only at the side. An inflamed state of Douglas's pouch may thus be made out also. (*f.*) The tenderness from hæmorrhoids may be recognized by directing the pressure backwards.

2. *The position and direction of the cervix.*—The normal condition has already been described. Version or even flexion of the uterus is rarely present without some change in the position and direction of the cervix. The diagnosis cannot be determined by this point alone, but it is a material aid in guiding the judgment. If the os is beyond the reach of the finger and looking backwards, probably there is anteversion; if nearer the os pubis than normal, and looking forwards, then the opposite condition. This evidence, however, must always be associated with what is determined as to the presence and position of increased resistance, or the feeling of solidity in different directions, with the form, amount, and fixedness of the solid body.

3. *The shape and consistence of the cervix with the degree of patency of the os.*—(*a.*) The *shape* of the cervix is sometimes diagnostic. If small and nipple-shaped, there is likely to be an undeveloped (infantile) uterus. A somewhat elongated and conical cervix is associated with constriction of the cervical canal, causing marked dysmenorrhœa. A small cervix, flattened in its superior border, with the os eccentric, is at times associated with congenital anteflexion, and constriction of the canal. (*b.*) The normal *consistence* has been likened, not inaptly, to that of the point of the nose. In the course of pregnancy it becomes softened and relaxed. In diseased conditions, it frequently becomes soft and velvety, with patency of the os. The cervix is often indurated (either in nodules or generally) in chronic endocervicitis, and in malignant disease. It is also subject to hypertrophic elongation which may affect either one or both lips. (*c.*) The shape of the cervix is changed in those who have borne children. It has lost its circular or slightly ovoid character with small round os; it is more or less fissured, oval, and unsymmetrical; at times a part or the whole of one lip may

be lost. In the atrophied condition in the aged, the vaginal portion may be entirely removed, the vagina seeming to end in a point. The changes in cancer will be afterwards described (see p. 426).

4. *Mobility of the cervix* is increased when there is prolapsus or a tendency thereto. It is diminished or absent in pelvic peritonitis or cellulitis, and in malignant disease.

5. *The sensation imparted to the finger by the vaginal walls* may be variously altered. There may be only the feeling of fulness of one side as compared with the other. From this there may be any degree of undefined resistance up to hardness and fixedness. These are associated with inflammatory conditions, and are rarely without tenderness on pressure. The swelling frequently alters the position of the os, which is pushed away from the side affected. If the increased resistance can be defined in shape, having a rounded character, its nature must be determined by its seat, size, consistence, and mobility, whether it is the body of the uterus, the ovary, something occupying Douglas's pouch, or a calculus. When possible, the uterine sound is required to decide the diagnosis.

When the position of the uterus is normal a portion of its body can be felt *through* the anterior wall of the vagina. In anteversion it can be felt more readily and to a greater extent, and the os is further removed. Inflammatory products (rare in this situation) are not so well defined and are less mobile than the uterus. A rounded tumor behind the cervix may be due to retroflexion, or to fluid or solid contents in Douglas's pouch; the size and consistence will sometimes suffice for a decision; or by the bi-manual examination, the fundus may be felt, behind the os pubis, whilst the tumor is still *in situ* behind.

The solidity of some forms of pelvic cellulitis cannot be felt by the finger *per vaginam* alone, but can be determined by the combined internal and external method.

When a hard tumor can be felt through the abdominal wall, and at the same time a hard fixed resistance through the vagina, it must not be inferred that there really is a *solid* tumor of the apparent size; such a condition is often produced by a matting together of the intestines, the broad ligament, and the Fallopian tube. The inflammatory hardening of a pelvic cellulitis will sometimes extend upwards beneath the peritoneum far up on the abdominal wall. The thin cake-like feeling of the superior edge and the immobility of the wall over the tumor, will readily distinguish this form.

When *lateral* movements (not merely downward pressure) can be conveyed from an abdominal tumor to the cervix uteri, it establishes a uterine connection. This character is of importance in determining between uterine and ovarian tumors. The diagnosis is completed by the use of the sound.

THE UTERINE SOUND AND ITS DIAGNOSTIC VALUE.—We have already alluded to the caution necessary in the use of this diagnostic aid, where there is a suspicion of pregnancy, and where there is pelvic inflammatory mischief. The sound originally proposed by Sir James Simpson is the best.

Mode of introduction.—The instrument should be held lightly by the right hand, and its point guided to the os by the forefinger of the left. As it enters the cervix the stem will be near the under surface of the symphysis pubis, parallel to the urethra. In the normal position of the uterus the direction of the canal is forwards and upwards. To cause the point of the instrument to take this direction the handle must be drawn backwards towards the perineum. When fully introduced it should rest on that structure. The distance the point has entered is recognized by the finger in the vagina. The knob or swelling, 2½ inches from the point, which indicates the normal length of the cavity, should be just at or within the os. Failure to introduce it thus far is often due to not tilting the handle sufficiently back. No force must be used, the instrument should glide in. If resistance is met with, move the ***point*** about, by making the sound turn on the forefinger resting on the point of curvature. Take special care that the stem is not made to rotate merely on its fixed extremity. If the position of the uterus is abnormal, the direction given to the sound must be varied according to the information obtained by the digital examination, or the sensation derived through the instrument itself. In retroversion the position and direction of the sound will be the reverse of that described as the normal.

Diagnostic value.—1. ***Constriction of the cervix*** may be recognized if the lumen be too small to permit the probe to pass. The narrowing from flexion may be recognized by the seat of arrest, and by the special manœuvre necessary to overcome it, such as tilting in a certain direction, or having to press the fundus upwards.

2. *The length of the cavity.*—The normal length is 2½ inches. It will be found ELONGATED in (*a*) recent delivery, the normal size is not reached till the third or fourth week. In repeated examinations a steadily diminishing length of the cavity is valuable evidence of recent parturition. Under various conditions the diminution in the size of the uterus is arrested (*subinvolution*)—after delivery at the full time and also after abortions. Usually in this condition it will be found 3½ inches, but it may be considerably beyond this. (*b*) In hypertrophy from chronic congestion, metritis, and malignant disease of the body (3½ inches). (*c*) From uterine tumors. The amount of elongation is greatly dependent upon their seat; if subperitoneal the increase may be slight; as they approach the mucous surface the tendency is to lengthen the cavity. A tumor of the fundus may give an apparent shortening. (*d*) The elongation may exist in the cervix only, or in its vaginal portion from hypertrophic elongation of both lips. It may thus measure 4 to 5 inches, and has been found as much as 9 inches (Huguier). The portion above the vagina may also be elongated from dragging of the uterus upwards by tumors. (*e*) The cavity is SHORTENED in defective development (infantile uterus); in inversion of the uterus; in tumors from adhesions; in the atrophic state in the aged; Sir James Simpson described a condition of hyper-involution, where the normal process has been in excess.

3. *Displacements of the uterus.*—These are readily determined by the direction in which the sound passes.

4. *To ascertain the connection or non-connection of tumors with the uterus.*—If the sound passes directly into the tumor it proves it to be uterine. A large sub-involuted uterus may thus be distinguished from other swellings. A swelling behind the cervix may thus be determined to be the fundus, or something occupying Douglas's pouch. If the sound does not pass directly into the tumor it may still be uterine, or have uterine attachments. The point is to be decided by moving the tumor, and observing whether motion is conveyed or not to the sound; or *vice versa*. The non-uterine nature will be further confirmed if, by aid of the sound, the uterus and tumor can be made to move simultaneously in different directions. In this manner small ovarian tumors can generally be differentiated.

5. The sound is further of service, in elevating the fundus or drawing it forward, so as to bring it within reach of the combined internal and external manipulation, to determine more accurately the size of the organ.

THE SPECULUM.—Ferguson's tubular glass speculum is the best adapted for general use. Of the bivalve form, that known as Cusco's is now most preferred. A good window light is the best; this should be on a level with the bed. Where the light is bad the tubular form of instruments has a decided superiority in illuminating power. Should artificial light be necessary, a shade should be devised to screen the observer's eyes, or a mirror may be used for reflecting the light, as in laryngoscopy.

The lateral position of the patient should, if possible, be adopted. It is less trying to her, and sufficient in the majority of cases. At times, however, with Ferguson's speculum, we may fail to gain a view of the os in the lateral position, when we may succeed in the dorsal. The shoulders of the patient must be on a higher level than the buttocks. The dress should be carefully adjusted so as not to expose any part of the thighs.

Having oiled the instrument, and holding it in the right hand, we gently separate the labia with the fingers of the left. With them for a guide, the instrument is presented at the orifice of the vagina; we then press it backwards so as to depress the perineum, and with a slight rotatory action introduce it within the orifice. The direction is now to be changed, backwards, to make it glide over the perineum, not upwards towards the uterus. When once fully introduced, the outward end should be depressed well on the perireum, and if the cervix does not present properly at the inner orifice, its position may be altered by a gentle rotatory movement of the speculum.

When the bivalve speculum is used, care must be taken that it is introduced fairly behind the cervix before the blades are expanded. The opening up of the blades must be done slowly and carefully, watching the effect meanwhile.

The above forms are those of general use, and are serviceable for inspection, or when topical applications to the uterus have to be made. When any surgical procedure is necessary, the "duckbill," or Sims' speculum, has decided advantages. It necessitates an assistant to hold it, but this drawback has been overcome by various modifications. In using it the position of the patient is of even greater importance than in the other forms. For its successful use there must come into play the dilatation of the vagina by air, when the contents of the abdomen are made to gravitate away from the pelvis. This is accomplished by placing the patient in the semi-prone position. She lies on the left side, the arm drawn backwards from under the side or placed above the head, the shoulders low, and the patient turned as much as possible in this position to lie on her face or front of the shoulder. In this position when the speculum is introduced, so that the convex surface presses back the perineum, air enters the vagina and distends it. The instrument is then introduced to the full extent and adjusted, so as to bring the cervix into view, and the handle entrusted to an assistant.

Uses of the speculum and appearances of the cervix.—By the above means a full view of the os uteri and vaginal portion of the cervix can be obtained. The mucous membrane of the vagina throughout its whole extent can also be inspected. This is best done in the withdrawal of the tubular instrument; the condition of the mucous membrane may be seen as it gradually folds in behind the speculum as it is withdrawn.

The cervix should present a smooth surface of uniform color. In the nulliparous, it is regular in form, with circular or slightly oval os; in those who have borne children it is often irregular in shape, and the os more or less fissured. In the latter case the use of the speculum, especially the bivalve form, tends to evert the lips of the cervix, and thus bring into view the redder, more highly injected surface of the canal; and this is liable to be mistaken for inflammatory injection. When the membrane is inflamed this eversion may be natural and not produced by the instrument. Slightly withdrawing or closing the instrument will distinguish between the two.

In catarrhal conditions of the cervical canal, the vaginal portion may be normal, but there is seen escaping from the os a clear glairy fluid, like white of egg. This becomes white and opaque in the vagina.

In addition to the angry-looking eversion of the lips, we may frequently meet with red patches extending to the vaginal surface, or isolated patches thereon. These are produced by injection or enlargement of the papillæ. If the epithelium is intact, the surface is smooth, but when it is removed the appearance presented is velvety or granular, and the membrane readily bleeds to the touch. Associated with this condition the cervix is frequently swollen and enlarged. Aphthous eruptions have been described, and more rarely small erosions are met with. Syphilitic ulcers, similar to those found on the glans penis, are also described.

Small mucous polypi and cysts, which have escaped the cognizance of the finger, may be detected by the eye. They arise from changes in the mucous glands within the canal. Minute cysts may be seen in the immediate neighborhood of the os, sometimes encircling it (*ovula Nabothi*); they feel hard and pearly, when punctured they collapse.

The changes in the cervix due to malignant disease will be described under that head. But it may be remarked here that when the disease is well pronounced, the nature can be determined by digital examination alone, and the use of the speculum should be limited to aiding the topical applications (see p. 426).

PELVIC INFLAMMATIONS.—Inflammation may invade only the peritoneum (perimetritis), or the cellular tissue of pelvis (parametritis), or it may be that both are affected together. Although clearly distinguishable pathologically, we are not yet in a position to lay down definite diagnostic signs between them. Tumors of large size, dense, firm or hard, may arise from matting together of the broad ligament and bowel; a thin structure, such as the peritoneum or a cyst wall, may, when inflamed, become hard, and give the feeling of a dense solid. Hence the difficulty in diagnosis.

Inflammation may exist without *hardness* or tumor. From the prominence given to these signs in the descriptions of pelvic cellulitis, many affections of truly inflammatory nature are frequently overlooked. *Fulness* and *tenderness* on one side of the pelvis may be the only signs present; just as the cheek may be swollen and tender from toothache without there being the hardness of a gum-boil. The cellular tissue on either side of the cervix may thus be acutely sensitive to the touch without being hard. This is often mistaken for tenderness of the uterus itself, but it may be readily distinguished by pressure upwards, to the one side, insufficient to move the uterus. Gentle pressure, by slight flexion of the first joint of the finger, is the best means to determine the exact seat of the affection; movement of the cervix will elicit pain if there is any inflammatory condition near it. With the tenderness in this situation careful comparison with the opposite side will generally enable one to detect a fulness or sense of increased resistance, corresponding to the seat of pain. This condition is very common, especially after childbirth or abortion, and also with endocervicitis; but the absence of hardness or tumor leads frequently to an oversight. A distinct hardness in this region is occasionally met with, narrow in character and extending laterally from the uterus, corresponding with, and limited to, the base of the broad ligament, and sometimes existing on both sides. More usually, however, it presents a form to be presently described.

Fulness and tenderness on one side of the vagina, not in such close relation to the cervix as in the former case, are met with from ovarian irritation or inflammation. A swollen and tender ovary may be defined by the finger through the vaginal wall. In an early condition the wall is movable over it, but it is liable to become fixed in the general swelling.

Hardness and fixation are generally combined. The hardness may be limited to the more strictly peri-uterine region, displacing and partially encircling the cervix, and having a rounded and defined margin. At other times the whole of one side of the pelvis feels solid without any defined margin or roundness. The latter swellings are clearly cellulitic, but with the former it is more difficult to say whether they are parametric or perimetric. When the tumor can be felt above the brim, occupying a clearly central position, not united to the walls, and especially if partial movement can be imparted to it, the probability is that it is peritonitic, and that the tumor is formed by the matting together of the different structures. Such tumors when they suppurate do not open externally.

Parametric tumors rise out of the pelvis in connection with the walls, extending into the iliac fossa, forwards on the anterior wall, or backwards along the psoas muscle. They are frequently to be felt above Poupart's ligament, and even extending high above it; but the connection with the abdominal wall can be readily determined. When suppuration occurs these tumors may point externally. It occurs not seldom that such tumors can only be felt externally, the hardness being beyond the range of the finger per vaginam. When the effusion is in relation to the cervix, the latter is usually displaced in position. If the inflammatory products are limited to Douglas's pouch, the uterus is pushed directly forward, but if the tissues to the side are also involved, there will be more or less lateral displacement. Displacement of the cervix towards the side corresponding with the inflammation, is met with in adhesive peritonitis. There is often some difficulty in discriminating between these inflammatory tumors and those arising from the effusion of blood (Pelvic Hæmatocele). In the acute form, the sudden onset of the affection, the rapid formation of the tumor, the evidence at first of fluid, and the changes in consistence of the swelling, accompanied, it may be, by pallor, faintness, and other evidence of loss of blood, are the chief points to be relied upon in forming an opinion. In the chronic form the question of diagnosis is more difficult. Ovarian tumors situated in the pelvis are not likely to be confounded with the swellings above described: their consistence and greater mobility are generally sufficient to distinguish them. It must be remembered, however, that an ovarian cyst may occupy the pouch of Douglas, and they are also found sometimes, though rarely, in front of the uterus.

CARCINOMA UTERI.—Malignant affections of the uterus occur most frequently from the fortieth to the fiftieth years, but both before and after these years they are not infrequent. Cancer is rare before twenty-five, but a few cases have been recorded; and it is occasionally to be met with even to the advanced age of seventy.

The symptoms in their sequence and grouping vary very considerably in different cases. There are three special symptoms, which, either singly or together, should arouse attention and demand a careful examination. They are pain, hemorrhage, and thin, watery, ichorous, sometimes offensive, discharge. Cases occur where one or other of them may be absent. Their duration also is variable, they may succeed or alternate with one another. In one case hemorrhage is the first to arrest attention, in another it is pain, in a third there may be only a thin watery discharge, occasionally tinged with blood. The pain has no definite character which is pathognomonic, and yet it can often be recognized. Persistency and a weary wearing out effect, with severe exacerbations, often periodic, are perhaps its special characteristics. Frequently it is a dull grinding, referred to the uterus, with sharp lancinating and radiating pains. The symptoms are valuable only when combined with the physical signs.

In the majority of cases the cervix is the portion affected, but cases where it is confined to the body are not so rare as at one time supposed. It is not often that an opportunity is afforded of examining a case in the earlier stage. The vaginal portion of the cervix becomes either uniformly indurated and tumefied, or numerous large tuberosities are formed, causing enlargement of this portion to three, four, or six times the normal size. The firmness diminishes, the canal becomes more patent, and as generally seen, there is presented a large ring or cup of indurated tissue, filled with softened pulpy tissue undergoing either sloughing or ulcerative changes. The uterus is at this stage fixed. The induration may have extended either as a general infiltration or as nodules along the vaginal wall, involving the bladder or rectum or both. At times the vagina may be so blocked up that the finger can be passed only a short way. Occasionally the disease may present a projecting mass of soft, brain-like, or cheesy substance, which fills up the whole vagina.

Epithelial or papillary cancer (cauliflower excrescence) is met with presenting somewhat similar characters. The cervix is enlarged and infiltrated; from its surface project numerous reddish colored, readily bleeding papillæ or granulations, which finally form a distinct outgrowth, irregular in form, and divided into lobules of various size. "They spring from the surface of the os uteri by a short thick pedicle or stem, the elongated and hypertrophied cervix, and then expand below into that peculiar *cauliflower*-like shape from which their name has been derived." At first a ring of apparently healthy tissue can be felt in the cervix above the tumor, through which, in operating, the detachment is effected. If left alone the disease soon extends upwards by infiltration, and the neighboring tissues become involved.

When the disease is limited to the body of the uterus the physical signs are less distinct. The organ is enlarged, the cavity may be lengthened, but it is also often shortened by the filling up of the space with the cancerous growth. The os is frequently patent. With these changes the diagnosis is dependent upon the accompanying symptoms, the frequent hemorrhages with ichorous and intercurrent offensive discharge: the pain is usually severe, and marked nocturnal exacerbations are frequently present. Certainty can be reached by removing—often by the finger nail—a small portion of the structure and examining by the microscope.

Fixity of the uterus, so constantly met with in the later stages of malignant disease, can be distinguished from that found in pelvic inflammations by the absence in the latter of the marked evidence of changes in the structure of the uterus itself met with in cancer.

A condition which is liable to be mistaken for malignant disease is where the cervix is enlarged, indurated, with patent os and ulcerated surface, the result of chronic inflammation. The absence of the surrounding infiltration and fixing of the uterus, and the characters of the ulcerated surface, will in most cases be sufficient to determine their nature.

The above diseases, from their frequency and importance, merit special attention. Into the diagnosis of the numerous affections to which the pelvic organs are liable, it is impossible, from the scope of the present work, to enter. But in conclusion we would remark that the cultivation of the habit of a careful and thorough exploration of the pelvis is the only sure means of guarding the practitioner against error. We frequently see the attendant contented with the diagnosis of some easily recognized condition, such as retroversion of the uterus, while he overlooks the true cause of the patient's suffering—pelvic peritonitis; or a pelvic cellulitis may remain unrecognized because no hardness is felt per vaginam; still more frequently debility and general symptoms have been attributed to the stomach, or to nursing, or to anæmia, when there was a pelvic origin for all, although this remained unrecognized, because the examination was too cursory, or perhaps never thought of at all.

CHAPTER XVI.

THE PHYSICAL EXAMINATION OF THE CHEST AND ABDOMEN.[1]

PART I.—PHYSICAL EXAMINATION OF THE LUNGS.

REGIONALLY the chest is usually divided as follows: The ANTERIOR REGIONS are the *supra-clavicular*, the *sub-clavicular*, the *mammary*, the *supra-sternal* (or the jugular fossa), and the *sternal* (upper, middle, and lower). The LATERAL REGIONS are the *axillary* and the *infra-axillary*. The POSTERIOR REGIONS are the *supra-scapular*, the *scapular* (including the supra- and infra-spinous spaces), the *inter-scapular*, and the *infra-scapular*.

No detailed description of these regions need be given, as the names speak for themselves, and in all cases where great exactitude is required, it is preferable to indicate the point to be noted, not by simply naming or subdividing the region in which it lies, but by taking some definite anatomical landmarks, such as a rib, the mid-sternum, or the clavicle, and giving exact measurements from these points. For this purpose the observer should always be provided with a measure of length, and it is well to have it doubly divided according to English inches and eighth-parts of an inch, and according to the French metric scale which, with its decimal subdivisions, is almost universally used on the continent in all medical observations. It is convenient also to have a scale of inches, or of centimetres, marked on the upper surface of the pleximeter, but care should be taken that the markings are accurate from end to end.

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[1] Amongst the books which may be consulted regarding the Chest are, the great works of Laennec on Mediate Auscultation, and of Skoda on Auscultation and Percussion, both of which are translated into English. The works of Gee on Auscultation and Percussion; of Austin Flint on the Physical Exploration of the chest; of Payne Cotton on Phthisis and the Stethoscope; and of Walshe on Diseases of the Heart and Lungs, are all of very great value.

In Cardiac Diagnosis, the works of Walshe, Hayden, George Balfour, and Sansom may be specially mentioned: the fourth volume of Reynolds's "System of Medicine" contains a series of articles on this subject. Gairdner's papers on Cardiac Murmurs (which have been freely used in this chapter) will be found in his "Clinical Medicine," and in the *Glasgow Medical Journal* for 1867.

In the Diagnosis of Abdominal Affections, Murchison, Budd, and Frerichs on Diseases of the Liver; Bennett on Leucocythæmia; Brinton, Fenwick, Wilson Fox, &c., on Diseases of the Stomach; Spencer Wells, Peaslee, and Atlee on Ovarian Disease; West, Graily Hewitt, Barnes, Thomas, and Sir James Simpson on the Diseases of Women, may all be named. See also Chapters xi., xiii., and xv. of this Manual, and some of the works mentioned there.

Amongst the older treatises of great value may be mentioned Bright on Abdominal Tumors, and Hope, Stokes, and Latham on Cardiac Diseases.

Those who can refer to the original works of Von Dusch, Paul Niemeyer, Gerhardt, Piorry, and Weil, will find much of great value in the physical examination of the organs.

The methods of investigation pursued in the physical examination of the lungs, are Inspection, Palpation, Mensuration, Percussion, and Auscultation.

INSPECTION.

This should be conducted, if possible, with the thorax quite exposed, but for a variety of reasons it often happens that only a partial view can be obtained. When it is possible, the patient should be placed in the sitting posture to enable the observer to view the chest from all points, and especially from above downwards over the shoulders. The light should be good and should fall directly on the chest; the attitude should be erect, yet unconstrained. Too long exposure of the chest is to be avoided, as there is often a danger of catching cold. The points to which attention is directed in this survey are:—(1) The shape of the chest; (2) The movements of its walls.

The Shape of the Chest.—This can be estimated in a general way by the eye; but the circumferential shape is accurately determined by the "cyrtometer," an instrument perfected by Woillez; and by it also the relation which the two halves of the thorax bear to each other can be gauged. A very handy form of cyrtometer can be improvised with two pieces of ordinary composition gas-pipe, united by a piece of india-rubber tubing as a joint. The joint is applied directly over the spinous processes and held firmly in position. The two pieces of pipe are then brought round the sides and moulded accurately to all the inequalities in the chest wall. They are crossed in front, the one above the other, and a mark should be made on them to indicate exactly the mesial line of the sternum. The joint allows them to be removed without destroying the "set;" the apparatus is adjusted on a sheet of paper, and a tracing made with pencil or ink. The measurement is usually made about an inch below the level of the nipple, or at the sterno-xiphoid joint.

In the healthy child the typical chest is somewhat circular, while in the adult it takes the form of an ellipse, the transverse diameter exceeding the antero-posterior[1] (see Fig. 64).

The variations from the typical forms are considerable, and are quite consistent, in many cases, with a healthy condition of the thoracic organs,—occupation, accident, and various conditions inducing the changes. There are, however, two typical deviations from the normal which are tolerably constant in their characters; the one is the "pigeon-breast," and the other the rickety chest.

In the *pigeon-breast* (Fig. 65) the sides are flattened, and the sternum is carried in advance like a keel. It occurs in childhood when the ribs are yielding and adapt themselves readily to any shape, from diseases in which great strain is thrown upon the lungs, as in whooping-cough, measles, &c., and is especially liable to take place in a rachitic subject.

The deformity that results from *rickets* alone is a contrast to this (see Fig. 66). In it a constriction occurs in the lateral region, and there is not the same sharp projection of the

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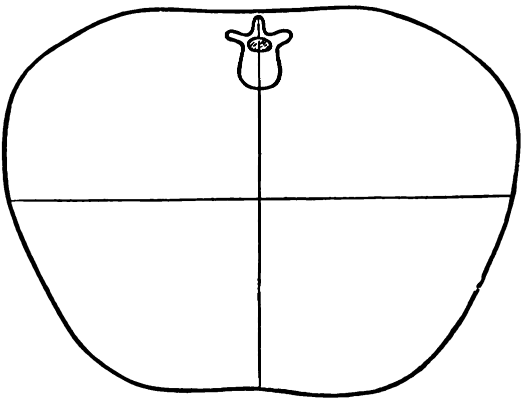
[1] The following table, given by Dr. Gee, illustrates the circumference, and the ratio of the diameters to the circumference in healthy chests at different ages. All the measurements are taken on a level with the sterno-xiphoid joint.

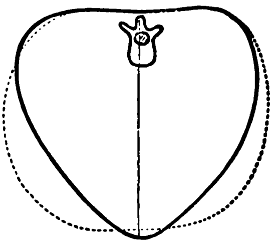
Age.	Actual Circumference.	Ratio of Diameters to Circumference.	
		Antero-posterior.	Transverse.
3 months . . .	14¾ inches (37.5 c.)	26	29
2 years	18 " (45.75 c.)	26	32
34 "	29⅗ " (75 c.)	26	35
48 "	35 " (89 c.)	27	31

sternum, as in the pigeon-breast. The chest, in fact, becomes somewhat quadrilateral. These deformities do not necessarily indicate disease of the lungs, but are frequently associated with it.



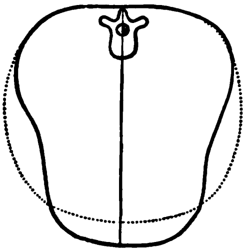
Circumference=89 centimeters.

Fig. 64.—Transverse section of healthy adult chest upon level of sterno-xiphoid articulation. (Dr. Gee.)



Circumference=37.5 centimeters.

Fig. 65.—PIGEON-BREAST. Tracing from a child of seven years. Dotted line indicates the natural shape at same age. (Dr. Gee.)



Circumference=42.75 centimeters.

Fig. 66.—RICKETY CHEST. Dotted line indicates the shape of chest in an infant about the same age. (Dr. Gee.)

The two sides of the chest are nearly symmetrical, the left, however, being usually a little less in circumference than the right. This symmetry is often impaired by local conditions which may be quite unimportant.

Emphysematous Chest.—In well-marked emphysema there is a reversion towards the infantile type, in respect of the altered proportion of the antero-posterior to the transverse diameter. (See the Table, p. 431.) The chest becomes more cylindrical, or, as it is often called, "barrel-shaped"; the sternum is more arched from above downwards than in the normal conditions, and the costal cartilages, along with the sternum, present also, an excessive arching transversely, so that the front of the bony case seems unnaturally bulged forward, while the lower ribs are laterally compressed. There is, however, this well-marked difference between the emphysematous and most of the infantile deformities, that in proportion as the former take place after the bony and cartilaginous structures have been consolidated, the changes are gradual and devoid of abruptness. We rarely or never find, accordingly, the pigeon-breast, or the depressed and incurvated

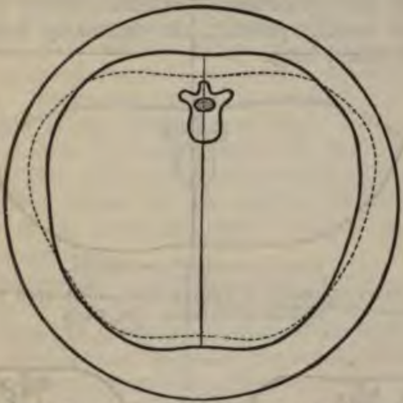


Fig. 67.—BILATERAL ENLARGEMENT OF EMPHYSEMA.

Inner line =emphysematous chest.

Outer line =a circle drawn to show how nearly the emphysematous approaches the circular shape.

Dotted line =natural adult chest.

Actual measurement in centimeters.

Circumference =	natural	87.	emphys.	87.75.
Transverse . . =	"	29.6	"	27.25.
Antero-posterior=	"	22.25	"	25.4

(Dr. Gee.)

ribs of the rickety infant among the emphysematous deformities of adult age.

Unilateral changes may also occur. There may be bulging of one side from effusion of fluid or air into the pleural sac; tumors of the lung, such as cancer, have a similar effect, and even in pneumonia, if it is extensive, there may be a slight but decided increase on the affected side. Retraction of one side may occur from cicatricial processes in the lung tissue, as in phthisis or abscess, or from the lung not expanding after the absorption of a pleural effusion of air or fluid. If the retraction is extreme, lateral curvature of the spine is usually present, the convexity being directed towards the sound lung.

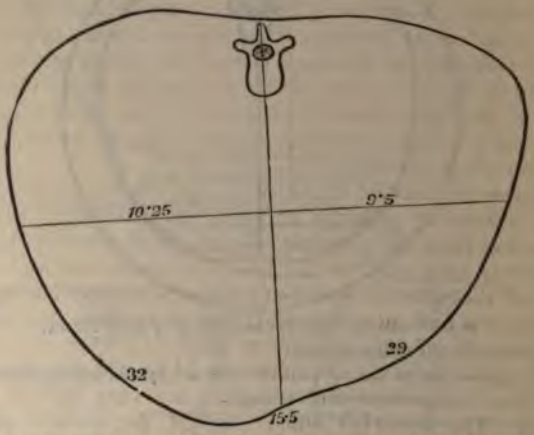


Fig. 68.—Unilateral retraction of chest; consequent upon cirrhosis of left lung in a girl of fourteen years. The figures indicate antero-posterior and transverse diameters, and semi-circumferences of right and left half of chest (Dr. Gee.)

The sub-clavicular regions always demand the most careful inspection, as a degree of flattening often attends the deposition of tubercle.

Local bulgings may occur in the chest wall, in the region of the heart, from pericardial effusion or extreme dilatation or hypertrophy of the organ itself; and aneurisms or tumors in any part of the chest may give rise to similar deformities.

Movements of the Chest Walls.—In estimating these, the student must keep before his mind the fact that in women the thorax moves more freely in respiration than in men:

the type being more thoracic in the female and more abdominal in the male. The movements should be observed first in quiet respiration, and then the patient should be directed to take one or two deep breaths, filling the chest slowly and fully. Both inspection and palpation should be brought to bear to determine the amount of movement.

The thoracic respiratory movement may be exaggerated; and this is especially the case when the descent of the diaphragm is impeded, as from tumors or other conditions in the abdominal cavity. On the other hand, the thoracic movement may be much restricted, and abdominal respiration greatly exaggerated, as in cases where the respiratory forces of the chest are at fault (as in paralysis of the muscles), and the whole work of respiration is thrown upon the diaphragm. There may, however, only be a deficiency in the expansion of the thorax as a whole, as in pronounced emphysema, or in the same disease the lower zone may be sucked in by the action of the diaphragm, while the upper half is forcibly raised by the scaleni and sterno-mastoid muscles, without, however, there being a corresponding amount of expansion.

Movement may be in abeyance over one side or the other, from extensive pleuritic effusion, pneumothorax, or from retraction from old pleuritic effusion; or the restricted movement may only exist at the base, the sound side and upper half of the affected one being thrown into undue motion. Pneumonia and other consolidations at the base and moderate pleuritic effusion give rise to this.

The movements at the apices should be critically observed, and here inspection and palpation are very usefully combined. The observer stands behind the patient with a thumb on either scapular spine, while the tips of his fingers lie over the apices in front immediately beneath the clavicles. The patient is then directed to inspire fully and quietly, and by watching the rise and fall of the fingers a very accurate comparison of the two sides can be made. Deficient expansion at either apex is a very important fact as indicating disease of the lung.

PALPATION.

This has already been referred to as a very important adjunct to inspection in determining the expansion of the upper part of the chest (*vide supra*), and it will naturally occur to the student to employ it in estimating more exactly than by inspection alone, deficient or undue movement in other parts of the thorax. Palpation will also determine the condition of the intercostal spaces which may be unduly prominent, resistant, and wide, as in cases of effusion into the pleura either of air or fluid, or in the region of the heart from pericardial effusion; or they may be diminished in size by the approximation of the ribs, as in cases of collapse or shrinking of the lung. Fluctuation or elasticity may sometimes be detected in the intercostal spaces in cases of fluid effusion, and in some instances pleuritic friction and the grating sensation present in some forms of emphysema may be realized. The condition of the vocal resonance and vocal fremitus, and the presence of pulsations and thrills (cardiac or aneurismal) are also to be noted, but these will be discussed under their respective heads (see pp. 447, 448, and 460).

MENSURATION.

If the circumference of the two sides is required, the student should first mark in ink the tips of the spinous processes of some of the vertebræ, and in a like manner the mesial line of the sternum. The circumference of the two sides is taken from these points, the measurements being made at exactly similar levels, the tape applied accurately to the chest wall, and the two observations made either on inspiration or expiration, or on both. The level most commonly selected for the measurements is about two inches below the nipple in a line with the sterno-xiphoid joint, the advantages of this situation being that it is quite free from bulky muscles and below the scapulæ. A very convenient method of measurement is by the double tape, which is simply two tapes joined. Their line of junction is placed exactly over the spinous processes, they are brought round on either side, and the circumferences of the two halves can be read off at once and their relative degrees of expansion noted.

In the average healthy chest the right side is usually found to exceed the left in circumference by about three-fourths of an inch. But the circumference of either side may be increased from morbid conditions, such as effusion of air or fluid into the pleura or pericardium, in unilateral emphysema, or in cases of tumor. In œdema of the chest wall also, if the patient lies habitually or for any length of time on the one side, the fluid will gravitate so as to increase the circumference on that side. But the circumference may be diminished from shrinking of the chest wall in collapse of the lung, after pleural effusion or from retraction in phthisis. Discrepancies may also arise from deformities of the walls or from curvature of the spine. (See shape of chest as gauged by the cyrtometer, Fig. 68, p. 434.)

The antero-posterior diameter of the chest may be estimated by the cyrtometer or by callipers, one blade being placed in front and the other behind; and the movements of respiration may be accurately determined by the "*chest measurer*" of Dr. Sibson, or the *stethometer* of Dr. Quain, both of which indicate on a dial the degree of expansion. The *spirometer* of Dr. Hutchinson, which measures the quantity of air breathed out, is used to determine the "vital capacity" of the lungs; while the *stethograph* of Ransome gives tracings of the movements of the chest walls. All these instruments, however, are of much more value in physiological than in clinical investigation. Dr. Ransome's "*chest rule*" may also occasionally be used with advantage to note accurately the area of any percussion-dulness, or the exact position of any pulsation, auscultatory phenomenon, &c., which it may be necessary to record.

PERCUSSION.

This may be performed without any instrument, the fingers of the one hand acting as the "plessor," and those of the other as the "pleximeter." But the ivory pleximeter of M. Piorry may be used and the stroke dealt by Wintrich's hammer. This last is as a rule only useful for purposes of demonstration to a large class or to educe sounds which require a strong stroke, *e. g.* the "cracked-pot sound" or to elicit the note in parts thickly padded with muscle as in the supra-spinous regions in the back. When the pleximeter is used it should be firmly and closely applied to the skin, the percussing stroke should be delivered on its centre, and if the finger is used as the plessor, care should be taken that the nail does not impinge upon the ivory. But the fingers give the most delicate results, and in very critical percussion they are indispensable, as they enable the percussor to estimate the degree of resistance to his stroke with greater delicacy than by any other method. The stroke should be delivered as directly and perpendicular as possible, with a well controlled movement from the wrist and not from the elbow. Care should be taken that no sound is generated by the contact of the nails. Occasionally immediate or direct percussion is employed, the fingers striking the chest wall directly. This is especially useful in the clavicular region, the bone acting as a kind of pleximeter.

In the back of the chest the lower limit of lung-percussion is on a level with the tenth or eleventh dorsal spine. In front on the right side it is bounded inferiorly by the upper border of hepatic dulness, *i. e.* about 1½ inches below the nipple, while on the left side it is bounded at the lower border of the third rib by the cardiac dulness, and in the left lateral region by the stomach and spleen. In the upper front, the apices of the lungs project to some extent above the clavicles into the supra-clavicular spaces.

The parts of the chest which should be most carefully percussed are the apices both in front and behind, the inter-scapular regions, the axillary regions, and the bases. Each point on one side should be carefully contrasted with a similar point on the other, and in many instances also with different parts on the same side. Every stroke should be made to yield results, and no spot should be lingered over separately and without comparison with others, as the ear is apt to get confused. If dull percussion is detected, especially in the lower part of the chest, it should be tested with the patient in various attitudes, for pleuritic effusions, if free, will be found, in some instances, to obey the law of fluid level, and the area of dulness will vary with the position of the patient. This is especially marked in cases of hydro-pneumothorax. In percussing above the clavicle, care should be taken that the stroke is directed away from the trachea. It is also well to remember that in health the percussion note of the left apex, especially in women, is often a little flatter than the right.

Over the healthy lung the percussion note is termed "*clear*" and the junior student will do well to contrast it carefully with the note obtained over the stomach, which is "*tympanitic*" and drum-like, and that over the liver, which is "*dull.*" No uniform standard can be set up for the pulmonary note in all cases, as there are so many modifying circumstances. For instance, if the chest walls are well covered with muscle or fat, the pulmonary note may be very obscure, especially in the back; and in such cases it is only by a careful comparison of all parts of the chest that the standard can be arrived at.

The percussion note over the lungs may depart from the normal in the direction either of *hyper-resonance* or of *dulness*. If over one side of the chest a frankly tympanitic note is got, pneumothorax should be suspected, and other signs will generally confirm the diagnosis. But a more localized and less pronounced tympanitic note may be obtained in many instances at the apex of a lung from tubercular excavation if near the surface; or where there is consolidation of the lower lobe as in pneumonia; or if the lower lobe is compressed by pleural effusion, especially if that effusion is advancing or beginning to recede. In these latter cases, however, the tympanitic quantity is usually associated with some diminution of resonance so that the note is so far dull. In emphysematous conditions of the lungs the mass of the percussion tone is increased or exaggerated, while at the same time it is lowered in pitch.

Dulness over the lungs may be due to changes in the organs themselves, or in the pleuræ. All forms of pulmonary condensations lead to it, such as pneumonia, tubercular or cancerous disease, œdema, congestion, collapse, &c. The dulness in such cases may affect any part of the lung, but in the great majority of instances the bases are chiefly involved. Tubercular consolidation is a marked exception to this, however, the apices being most frequently affected, the first hints of it being often obtained by a change in the percussion note in the supra-clavicular spaces.

Dulness depending on changes in the pleura may result from thick layers of lymph or fluid effusion, in which, if it is moderate and free, the dulness will gravitate to the base, but if the effusion is large the whole side may yield an absolutely dull note, and it may even cross the mesial line, and reach above the clavicle (see Fig. 73, p. 460). The dull note in rare cases may depend on pneumothorax, where the air is present in such quantity as to distend the pleural cavity to its utmost. If a little air is let off in such instances by a hollow needle, a tympanitic note becomes developed. Thickening of the pleura will diminish the pulmonary resonance, and in collapse of the lung with retraction of the side, it will, of course, be seriously impaired if not altogether lost.

But areas of dull percussion may occur from other causes than changes in the lungs or pleuræ. Thus aneurisms or dilatations of the aorta, glandular tumors, cancer, pericardial effusion, or dilated or hypertrophied conditions of the heart may encroach on the limits of lung-percussion. These areas should be carefully mapped out, and other signs will usually guide the diagnosis. The displacements of the heart are considered under the head of cardiac diagnosis (see page 459).

The cracked-pot sound (Bruit de pot fêlé) demands special mention. It is a modification of the tympanitic, and can be well imitated by striking the hands folded across each other over the knee. The best method to elicit it is by a strong stroke, and this is one of the instances for the use of the percussing hammer. The patient should keep his mouth open and breathe quietly. In the adult this sign generally indicates a cavity in the lungs, but it may be present in healthy children, owing to the yielding nature of the chest walls. Walshe says it is usually got over the chest of a crying infant on expiration. If a patient, who develops this sign, inspires deeply and then holds his breath, the cracked-pot sound will disappear.

AUSCULTATION.

Auscultation of the lungs may be conducted either *mediately* by the stethoscope, or *immediately* by the application of the ear to the chest wall. The former is the method more commonly employed in this country, although in certain instances, especially in the auscultation of children, who are easily frightened by the sight or pressure of the stethoscope, the direct method may be more advantageous. In adults also it is often well to auscultate the back of the chest *immediately*, a thin soft towel or handkerchief being interposed between the ear and the skin. In selecting a stethoscope the student should see that it fits his ear accurately. The form of the instrument is not of very much consequence, and it may be made of metal, vulcanite, or wood. The ear-piece should be large enough to cover the whole concha, say from 2½ to 2¾ inches in diameter, and slightly concave to admit of the exact application of the ear. The bell should be large enough to bridge over an intercostal space, from one and a sixth to one and a quarter inch in diameter.

When used the stethoscope should be applied directly to the chest without the intervention of any clothing, and it is necessary that it should be planted quite fairly, so that the whole of the circumference of the bell may be in contact with the skin. Moderate pressure with the head will keep it in position, but care should be taken that undue pressure is not exerted, as it not only causes pain but may even impede respiration to some extent. Beginners, as a rule, are apt to press far too heavily. Care must be taken to obviate friction between any part of the patient's dress and the stethoscope, or between the patient's dress and his skin in the vicinity of the instrument. In patients who have much hair developed on the chest, the student must be careful that he does not mistake the friction of the hair with the stethoscope during the act of respiration for an intrathoracic sound. This fallacy may be avoided by shaving the part, or having the bell of the stethoscope shod with a piece of india-rubber. The *differential stethoscope* of Dr. Scott Alison may occasionally be employed in the physical examination of the lungs, but it is of much more importance in cardiac diagnosis, especially in determining the rhythm of murmurs. It consists simply of two stethoscopes, with flexible stems, leading separately to each ear, and connected by a joint. The ear-pieces are small and fit into the ears, while the flexible stems allow of the bells being placed at a greater or less distance from each other according to the desire of the auscultator. A new form of differential stethoscope has been introduced by Dr. Spencer, in which the sounds from each tube are communicated to both ears.

During auscultation both the patient and the observer should be in an easy posture. The patient should lie quite flat or sit unconstrainedly, all muscular effort being in abeyance, and the auscultator should avoid stooping or straining too much over the patient. A very thorough examination can also be made with the patient standing erect, a blanket or shawl being cast over his shoulders to prevent any chill. The examination should be carried out quietly and systematically, the various regions of the chest being, as far as possible, symmetrically examined and carefully contrasted. It is often necessary also to contrast different parts on the same side. The patient should be directed to breathe quietly or forcibly, according as circumstances demand, and it is well in most cases to listen under both conditions, always taking care, however, that quiet respiration is first selected. A fact of importance is, that forced inspiration should not be performed spasmodically, or with noise in the mouth or nose, but slowly and quietly. A thorough examination of all parts of the lung is necessary, but special attention should be paid to the apex, both in front and behind, to the axillary region, the inter-scapular region, to the base behind, and to any region where pain is complained of. The student must be careful not to confuse his ear by lingering too long over the same spot; it is much better to return to it. The examination should be conducted with as little fatigue to the patient as possible, and with this end in view, as well as to avoid unnecessary repetition, each spot on the one side should be compared with a corresponding point on the other: exact comparative results are thus obtained.

The principal objects for which auscultation of the lungs is practised are: 1, To ascertain the condition of the respiratory murmur or breath sounds; 2, To detect the presence of any superadded abnormal sounds or râles; 3, To ascertain any alteration in the vocal resonance or fremitus, or in the transmission of the heart's sounds.

BREATH SOUNDS.

To ascertain the condition of the breath sounds. In this as in all other departments of physical diagnosis, the student must be acquainted with the healthy phenomena before he can hope to detect morbid changes. There are three facts then with which he must make himself perfectly familiar in the healthy chest, viz., the character of the breath sounds as heard over the trachea, over a bronchial tube, and over the spongy lung tissue. The breath sounds *over the trachea* are loud, hollow, articulate, and the expiration and inspiration are equal in length and intensity, but separated by a distinct interval. *Bronchial respiration* is heard to greatest advantage near the sterno-clavicular articulations or in the inter-scapular spaces near the spine. It approximates in character to the tracheal, but is less pronounced.

The vesicular or respiratory murmur proper is heard over the spongy lung, and may be found in its most typical form in the lower half of the back, two or three inches from the spine, or in the lateral region. It is soft, breezy, and uniform; and although the inspiratory and expiratory sounds are the same in quality, they differ in degree and prolongation, the expiratory being less loud and only about one-third the length of the inspiratory. The interval between the two acts is of very short duration. It is to be remarked that the inspiratory murmur is normally louder and harsher in children than in adults (hence called *puerile*), that in old age it tends to become feebler, and that it is usually more marked in men than in women. It is also to be expected that in an emaciated subject the respiratory murmur will be more audible than in one with well-developed muscular and fatty tissues. Besides these there are variations which cannot be accounted for on any physical principle, and which may be regarded as individual peculiarities, some men having extremely feeble, almost inappreciable respiratory murmur throughout the chest, while others have respiration which may almost be described as puerile, both conditions being quite compatible with an absolutely normal state of the lungs and air passages.

The vesicular murmur may undergo various changes in disease. It may become *weakened or suppressed.* Weakening of the respiratory murmur may result from some obstruction, such as pressure of an aneurism on a bronchus, or spasm of a bronchus; or from some obstruction in the larynx and trachea hindering the free admission of air into the pulmonary vesicles. It may also result from pulmonary condensation, collapse, or emphysema. Absolute suppression occurs in cases of large effusion either of serum (hydrothorax), or of pus (empyema), or of air (pneumothorax), into the pleural sac. In certain cases of condensation and collapse of the lung, the respiratory murmur may be quite suppressed or replaced by some other form of respiration, such as the bronchial.

The respiratory murmur may be *exaggerated*, or as it is technically called *puerile.* In children the normal respiratory murmur is of this type, but in the adult its presence usually indicates that although the part of the lung over which it is heard may be healthy, some other part is suffering from causes leading to suppression or diminution of the respiratory murmur. It is heard at the apex of a lung, for instance, when the lower part is compressed by pleuritic effusion, or when the base is consolidated; or if owing to any cause the function of one lung is much crippled, the respiratory murmur is often exaggerated on the other side. All these facts indicate its compensatory nature.

Jerky, wavy, sighing, or cog-wheel respiration, is the term applied to the respiratory murmur when it loses its continuous character and gets broken up into parts, or into a series of little waves. It is the inspiratory murmur almost exclusively which is affected in this manner. It is not indicative of any positive disease, but should always be regarded with suspicion, especially if it is local and at the apex, as an early indication of phthisis.

Prolongation of the expiration. It has already been stated that normally the expiratory murmur is much shorter than the inspiratory, but in many cases it becomes so lengthened as to equal the inspiration, and in some instances even to exceed it. It is a frequent indication of the early stage of tubercular deposition, and in such cases is usually associated with a degree of harshness or exaggeration of the respiratory murmur. In vesicular emphysema, owing to over-distension of the air vesicles and consequent loss of elasticity in their walls, this prolongation of the expiration is very marked, and is associated with weakening of the inspiratory murmur.

But the respiratory murmur, besides these alterations in it, may come to assume a totally different quality; it is replaced, in fact, by breathing of another type. The changes in quality are indicated by the terms *Bronchial, Tubular, Cavernous, and Amphoric.* Several of these differ most probably only in degree, and all of them may be heard at different stages in a case of phthisis going on to excavation, as well as in other affections having a similar tendency.

Bronchial and Tubular respiration, as has been already stated, is heard in the healthy subject over the trachea and large bronchi, but in certain forms of disease it is present over the spongy lung. It occurs in consolidation and collapse. It is heard in pneumonia in the stage of hepatization, in phthisis, and in cancer of the lung. It is occasionally also heard in cases of pleuritic effusion. In pleurisy, with large effusion, where the lung is squeezed to the upper and back part of the chest, bronchial respiration is often heard in this situation.

Cavernous respiration has the same hollow and articulate quality as that heard over the trachea, and if these characters are present over a limited area and not in the immediate vicinity of a bronchial tube, and especially if associated with the metallic phenomena (to be afterwards described), the probability is that a cavity exists. All conditions that lead to excavation in the lung tissue produce it, and among these phthisis is by far the most frequent. Dilated bronchi may also give rise to it. Amorphic respiration is just a more exquisite degree of the cavernous, and can be well imitated by blowing across the mouth of a large empty jar. It is heard in large intra-pulmonary cavities, and in cases of thorax where there is a communication between the lung and the pleural sac. (See also p. 446.)

RÂLES.

The respiratory murmur, however, may be accompanied or replaced by other sounds called Râles. These may be classified as—(1) Sonorous and Sibilant; (2) Mucous or Bubbling; (3) Crepitant. Friction sound is not usually classified among the râles, but, in many instances, it so closely resembles or is so closely simulated by intra-pulmonary sounds, that it seems well to treat of it in this connection. Various combinations of these râles occur and must be named accordingly.

Sonorous and sibilant râles. These are dry and somewhat musical; they are caused probably by some obstruction to the tide of air in the bronchial tubes. The sonorous or snoring râles are of a grave pitch, loud, and usually accompany both inspiration and expiration, but the pitch may vary in the two acts. The sibilant (wheezing, whistling, cooing, &c.) are high in pitch, but in other characters resemble the sonorous. These râles are heard most typically in acute and chronic bronchitis; and in asthma, from spasmodic constriction of the bronchial tubes. The two forms of râle are usually associated; they vary much from time to time, and may disappear after a cough.

Bubbling or mucous râle. This râle, in typical form, unquestionably gives the ear the impression of moisture, like the bubbling of air through some viscid fluid. It often exists both with inspiration and expiration, and varies greatly in its degree, sometimes approaching to the characters of the crepitant râle, and then called "sub-crepitant" by some authors, while at other times it is large, coarse, and quite decidedly mucous. It may, in severe cases, be present all over the lung, but as a rule is most abundant at the base. It is common in bronchitis where the secretion of mucus is abundant; in œdematous states of the lung owing to disease of the heart or kidneys; and in certain fevers, such as typhus, owing to congestion. In the stage of resolution in pneumonia the râle known as the *crepitus redux* is essentially a mucous râle, and the *clicking râle* of phthisis is also moist. This râle in phthisis is so significant as to demand special mention. It is very distinctly moist and clicking, often very scanty, limited in its area, chiefly accompanying inspiration, and having a marked tendency to develop at the apices. It is very significant of softening tubercle. *The cavernous râle* may also be considered as a modification of the mucous. It is present in cases of cavity from tubercular disease or dilated bronchi. It usually accompanies both expiration and inspiration, is heard over a limited area, and if the patient coughs it often has a splashing or gurgling quality, each splash being followed by an aftertone or echo.

Crepitant râle. This is a finer râle than the mucous, and is not distinctly moist. It is heard in its typical form in the first stage of pneumonia, prior to consolidation, and constitutes the *pneumonic crepitus.* This is heard, as a rule, on inspiration only, often just at the end of it, and consists of a number of minute crackles. It can be well simulated by rubbing a lock of hair between the fingers near the ear. The râle is extinguished on the supervention of bronchial respiration. Crepitant râle is also present in œdema of the lungs, and acute capillary bronchitis, and certain forms of pleuritic friction often closely resemble it.

Friction sound is produced in the pleura, owing to the roughened surfaces grating on each other, and in its most exquisite form it is easy of recognition. It is distinctly rubbing or grating, very superficial, and usually accompanies both expiration and inspiration, but it may be with inspiration alone. Its most frequent seats are in the mammary region, in the lateral region in the line of the axilla, or further round, near the inferior angle of the scapula. It is often accompanied by an unchanged condition of the respiratory murmur, and forced inspiration and coughing do not obliterate it; indeed, forced inspiration is often required to bring it out. In many cases its characters are not so pronounced, and it is often mixed up with intra-pulmonary râles, which tend further to obscure the diagnosis. In rare cases friction is caused in a roughened pleura by the cardiac action. This is heard on the confines of the heart, and is distinctly related to the cardiac action, as may be found by its continuing when we get the patient to stop breathing.

METALLIC AND AMPHORIC PHENOMENA.

There is yet a certain group of auscultatory signs which may be classed under the title of Metallic Phenomena. These are Metallic Tinkling, Amphoric Echo, the Bell Sound, and Hippocratic Succussion. All these phenomena are very variable in their degree and persistence, and they occur in different combinations.

Metallic tinkling is well described by Laennec as "a peculiar sound, which bears a striking resemblance to that emitted by a cup of metal, glass, or porcelain when gently struck with a pin, or into which a grain of sand is dropped." It may be heard with respiration, voice, or cough—most typically with the last two. It is very significant of cavity, and is present in large pulmonary excavations when near the surface of the lung, and also in pneumothorax.

Amphoric Echo. This term is applied when the voice, cough, or breath sounds have an intensely hollow resonance, and it can be well imitated by speaking, coughing, or breathing into a large empty jar. It very frequently accompanies metallic tinkling, or may be interchangeable with it. It is only present when large masses of air are thrown into vibration, and occurs most frequently in pneumothorax, although it may occasionally be heard in intra-pulmonary cavities of large size. It may accompany respiration, voice, or cough, but is usually most pronounced with the two last.

The Bell Sound may be elicited by percussing the chest with two coins (half-crowns do very well), the one coin being used as the pleximeter and the other as the plessor. If percussion is made at the front of the chest the auscultator applies his ear to the same side behind, and he may hear a clear ringing sound. This sign is almost exclusively confined to pneumothorax.

Hippocratic Succussion is produced when there is a mixture of air and fluid in the pleural sac (Hydro- or Pyopneumothorax). The best way to elicit it is for the auscultator to apply his ear directly to the back or side of the chest and, half embracing the patient, to give him a shake. The sound heard is similar to what is got by shaking a cask which contains air and fluid.

VOCAL RESONANCE AND FREMITUS.

The next great object of auscultation over the lungs is to ascertain any alteration in the vocal resonance or fremitus, or in the transmission of the heart's sounds.

Vocal resonance is the term applied to the vibrations caused by the voice of the patient transmitted through the chest to the ear of the auscultator. It is best elicited by causing the patient to say "twenty-one," "twenty-two," "twenty-three," in his natural voice. It is, as a rule, most distinct in adult males, especially if the voice is grave in pitch, but it is subject to such variations, that in the absence of other signs of disease little diagnostic importance can be attached to it. It is well to recollect also, that even in health it is louder in most cases at the apex of the right lung than of the left. Over the spongy lung the vocal resonance is simply an indistinct buzzing, but if listened to over the trachea, it is found to be loud and near the ear, every syllable is quite appreciable even when whispered. This is almost identical with *pectoriloquy*, in which the sounds appear to be transmitted directly into the ear from the chest. Over the site of the larger bronchi the voice possesses a less degree of distinctness and intensity, and to this is applied the term *bronchophony.*

In disease the vocal resonance, over what is normally the spongy lung, may approximate to *bronchophony* or *pectoriloquy.* The change in the direction of bronchophony depends chiefly on consolidation, and is often present in pneumonia, phthisis, and other condensations. Laennec believed pectoriloquy (but only in that degree which he termed "perfect pectoriloquy") to be pathognomonic of cavity in the lung, and no doubt it is a frequent associate of this condition, and a valuable fact in conjunction with other signs, but it may also be heard in cases of consolidation, such as those mentioned above.

Ægophony was the name applied by Laennec to a peculiar modification of the vocal resonance which is high in pitch, very tremulous, and closely resembles the bleating of a goat, or the voice of Punch in the puppet show. It is rarely found in perfection, but degrees of it are not uncommon, and its most frequent site is near the inferior angle of the scapula. Laennec thought it depended on the interposition of a thin stratum of fluid between the layers of the pleura, but it is also found in the course of pneumonia, and in inflammatory thickening of the pleura. Its cause is still a matter of dispute.

Autophony is a term used to denote increased resonance of the auscultator's voice if he speaks while he has his ear applied to the patient's chest. He hears the tones of his voice intensified. This phenomenon is heard more or less in most of the cases where bronchophony is developed, but it is chiefly marked in cases of large cavity, especially pneumothorax.

The *vocal resonance may be absent* in certain cases, and this is an important fact if the resonance was known to have existed previously; or it may be absent only on one side or one part. This points to some obstacle to the transmission of the sound, chiefly owing to fluid effusion or some obstruction in the bronchial tubes. (For amphoric voice in pneumothorax see page 447.)

The *vocal fremitus* is closely allied to vocal resonance. It is the sensation communicated to the hand placed on the patient's chest while he speaks. This is also subject to great variation, consistent with perfect health, but it may be stated as a general rule, that conditions leading to increase or diminution of the vocal resonance apply to vocal fremitus. It is thus generally increased in consolidation of the lung, and diminished in pleuritic effusion.

In certain diseased conditions of the lungs the heart's sounds may be transmitted widely over the pulmonary area. This is especially the case in all forms of consolidation, and when this transmission is to the apices of the lungs, and especially to the right, it is often significant of phthisical consolidation. The heart's sounds may be altered in quality owing to diseased conditions in the lung, but these will be noticed under the physical diagnosis of the heart.

PART II.—PHYSICAL EXAMINATION OF THE HEART.

In the physical examination of the heart the same methods of investigation are employed as in the case of the lungs, viz., *Inspection, Palpation, Percussion, and Auscultation.*

It is of great importance for the beginner to practise frequently the

EXAMINATION OF THE NORMAL HEART.

The first point of importance for the student to note is the *contour of the chest-wall* in front of, and inclosing the organ. In the healthy chest the left is usually symmetrical with the right side, but, as will afterwards be seen, certain diseases may cause alterations in respect of this symmetry, which may have a diagnostic importance. Having inspected the precordial region, and having noted the fact of any visible pulsation, whether diffused over the cardiac area, or localized to the apex-region, the epigastrium, or other part of the chest, the next point to determine, if possible, is the exact *position of the apex-beat*. In many cases this corresponds with a visible pulsation which will have been noted in the preliminary survey, but in not a few instances no such distinct pulsation is seen, and careful search by palpation must be made for the apex. In all cases, whether there is a visible apex-beat or not, the intercostal spaces in the precordial region should be separately examined with the tips of the index and middle fingers, in order to fix if possible the exact spot at which the apex, or rather the most superficial part of the left ventricle, strikes the chest wall. The most favorable opportunity for this is in expiration, when, by the recession of the lung, the heart approximates itself most closely to the ribs; but the state of expiration must not be long maintained, otherwise the apex-beat becomes obscure from other causes (see foot-note, p. 453).

In the normal chest, in the recumbent posture, the apex-beat is usually found in the fifth intercostal space, slightly inside the vertical line of the nipple. It is to be remembered, however, that the site of the nipple varies to some extent even in males, and in women its position is ruled by the degree of development and laxity of the mamma, and so its relation to the apex-beat is by no means constant. The usual position of the apex-beat is as above indicated; but in not a few instances, even in healthy subjects, no distinct impulse exists while the patient is in dorsal decubitus, and only a comparatively feeble pulsation is felt in the fourth or fifth intercostal space. In such a case the patient should be turned on his left side well round on the face. This change in posture favors the gravitation of the heart to the surface of the chest, and to the left side, so that an apex-beat that was almost imperceptible in the recumbent position may become distinct. Under such circumstances, allowance must be made for its being carried more to the left, but the degree of this varies in different subjects according to the laxity of the tissues which bind the heart. Percussion may assist in determining to some extent the site of the apex as it is usually found immediately inside the left border of the precordial dulness. But the student should also use the stethoscope in aid of palpation in determining this most important fact, and it is specially useful where no tangible apex-beat exists. For this purpose he should auscultate in the apex-region till a spot is found, over which the first sound of the heart has the most definite and superficial character, and this may be assumed to be the point at which the wall of the left ventricle comes nearest to the surface.

Having determined as nearly as posible the position of the apex-beat, it should be marked (with ink or otherwise), and the next step is to appreciate thoroughly *the nature of the impulse.* This can be done either with the tips of the fingers or the ball of the thumb, the former, however, yielding the more accurate results. In healthy subjects in whom a tangible apex-beat exists, it is limited in area, well-defined, and punctuate, and in those in whom it is not present in the recumbent posture, but is developed when they are laid over on the left side, it presents similar characters. Changes in neighboring organs may have so altered the relations of the apex as to obscure its impulse in all positions, and such a condition is to be noted, but it does not necessarily indicate disease of the heart. A punctuate apex-beat may also be wanting in healthy subjects from the fact that the impulse is delivered against a rib and does not reach an intercostal space. In the strictly healthy subject no considerable impulse exists over the right ventricle, but a degree of this can be educed by sudden exertion, and it may be discriminated from the apex-beat. This impulse or heave is best appreciated by the ball of the thumb or palm of the hand placed over the region of the right ventricle. It can also be well appreciated by the direct application of the ear when the impulse is communicated to the head. The student should notice this impulse carefully, as in some diseased conditions it is of much diagnostic value. In widely diffused impulse the point furthest to the left, giving a distinct and direct impact, is to be regarded as the most probable site of the apex, but it does not necessarily follow in such cases that the real apex of the left ventricle produces any sensible and separate impact at all.

Percussion of the heart is the next step in the examination. In women in whom the mamma is large and flabby it should be drawn up or to one side while the percussion is being followed out. The area of precordial dulness will vary somewhat according to the strength of the percussing stroke. If the deep or relative percussion dulness is wanted, a comparatively strong stroke is necessary, and the percussion should be made as far as possible during expiration, while the heart is most uncovered. If, however, the superficial or absolute dulness is required, the lightest stroke should be employed, in order to determine accurately only that part of the heart which is most superficial. The student should familiarize himself with both methods, but in the description here given the latter is the one chiefly in view. It is best to percuss from the clear area of lung on to the dull area of heart, and commencing with the right border, the student should appreciate thoroughly the clear note over the right lung and then percuss towards the middle line, noting the point at which the clear pulmonary note becomes modified. Having percussed the whole of the right border in this manner he should proceed to the left, to which the position of the apex-beat will afford a guide. To delimit

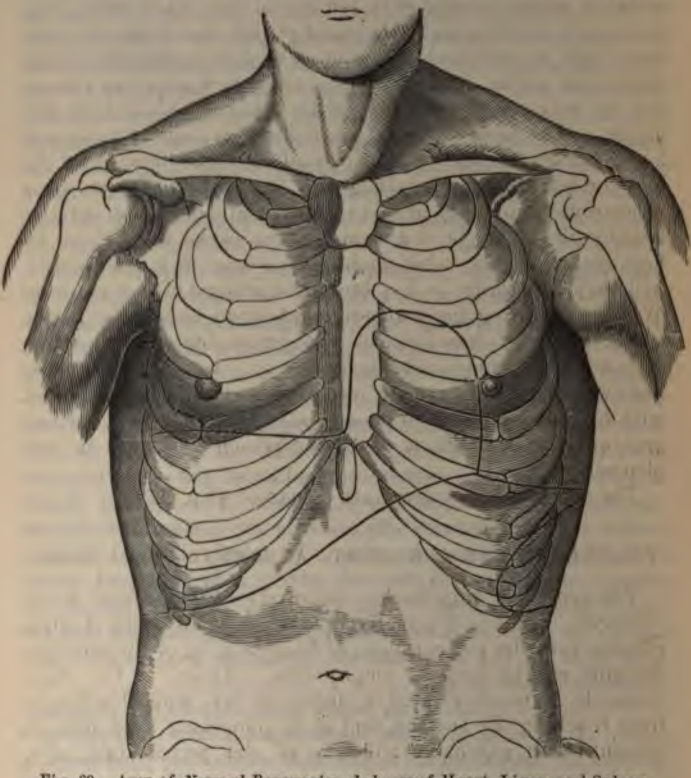


Fig. 69.—Area of ***Normal Percussion-dulness*** of Heart, Liver, and Spleen. (Slightly modified from Weil.)

the upper border, percussion is to be made from the left intraclavicular region downwards. The lower border of cardiac dulness cannot, as a rule, be separated from that of liver. It is useful to indicate these limits of percussion-dulness by marking them with ink or crayon. The right border of the dulness to superficial percussion will be found usually to coincide pretty exactly with the mesial line, while with deep percussion it will pass to the right of that line from one inch and a half to two inches. The left border, as a rule, coincides with a line about half an inch outside the apex-beat, and so corresponding nearly with the vertical line of the nipple. The upper margin of dulness is usually near the lower border of the third rib, and it slopes downward to join the left margin (see Diagram, No. 69). The transverse measurement of this area to superficial percussion in the healthy chest may be stated approximately at from three to four inches in the adult male. In women it is less, and it will vary according to the build and stature of the subject. While performing the percussion attention should be given to the sense of resistance to the percussing stroke, as an increase in this may assist the diagnosis. In many instances, however, the delimitation of the cardiac dulness is interfered with by the occurrence of consolidation in either lung in close proximity to the heart, or by the presence of fluid in the pleuræ.

The Sounds of the heart are discussed at p. 461.

CHANGES IN THE APEX-BEAT—ABNORMAL PULSATIONS.

The apex-beat may become inappreciable or at least much obscured. This is especially apt to occur in cases of fluid effusion into the pericardium, or from bulging of the anterior margins of the lung in emphysema. Again, if the right ventricle is much dilated it pushes the left aside, hinders it from reaching the surface, and so no punctuate apex-beat is present.[1] In extensive adhesion of the pericardium also, there is often no distinct apex-impulse forward, but rather a systolic retraction of one or two of the intercostal spaces in the vicinity of the apex-region, while at the same time the heart has a jogging or tumbling action. The absence or want of precision of the apex-beat may thus indicate disease either of the heart itself or of some of the neighboring organs.

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[1] Apart from diseased conditions altogether, a very simple experiment, which any one can make on himself, will demonstrate the effect which a distended right ventricle has on the apex-beat. When lying in an easy position a finger is put on the apex-beat, and its character carefully noted, while with the other hand the pulse of some of the arteries is felt. Respiration is then simply suspended without any deep preliminary inspiration. As the sense of suffocation approaches, the apex-beat grows gradually more indistinct, and may even disappear, while the heave of the right

The *apex-impulse may be exaggerated.* This is generally the case in hypertrophy of the left ventricle, in which also it is usually displaced downwards and to the left.

The apex-beat is often displaced. It may be found displaced *downwards and towards the left*, so as to be felt in the 6th, 7th, or 8th intercostal space, several inches outside the nipple line. Under such circumstances the impulse is usually much increased in intensity, and so wide-spread as to be visible in two or three intercostal spaces. This is usually found in hypertrophy, chiefly involving the left ventricle. The apex-beat may come to be *displaced upwards*, owing to pressure on the diaphragm of abdominal tumors, ovarian disease, ascites, enlargement of liver, &c., or it may be dragged upwards by a shrinking of the left lung, as in phthisis, with contracting cavities in the apex, or from retraction of one side of the chest after the absorption of an effusion. In considerable pericardial effusion the apex-beat is apt to be raised, and the same is said to occur in cases of adherent pericardium. It may be found *displaced either to the right or left* by fluid or air in the pleuræ (Hydrothorax or Pneumothorax). The displacement is much greater when the effusion is in the left pleura, and, if it is extreme, the heart may be found beating under the right nipple. This condition has been called by the late Dr. Stokes, *Dexiocardia* (see Fig. 73). The impulse, however, which is felt in such a case is not from the apex of the left ventricle, but from some part of the right. The heart may remain displaced after the effusion disappears, through the influence of

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ventricle becomes very marked. The pulse, however, is not affected to any extent, except perhaps being a little smaller, and this shows that the left ventricle is still contracting quite efficiently although the apex-impulse has become obscure; owing to the repletion of the right ventricle the left is, as it were, thrown behind and cannot reach the chest wall. When respiration is resumed the apex-beat becomes apparent at once. These conditions are quite independent of the expansion of the lung, being equally appreciable in inspiration or expiration.

adhesions. Changes in the character of the apex-impulse are also to be noted. It may become unduly strong and heaving in hypertrophy, or weak in cases of dilatation and fatty degeneration. Its regularity, or the reverse, in rhythm and force, must also be attended to.

Centres, other than the apex-beat, may become developed in diseased conditions. In certain cases, coincidently with a want of distinct apex-beat, there is an undue development of the *impulse or heave of the right ventricle.* This is especially the case in dilatation or hypertrophy of the right side of the heart. A diffused impulse is then appreciable over the region of the right ventricle, which is often propagated into the epigastrium, through the left lobe of the liver, in the form of a wide-spread pulsation, and in certain cases of displacement of the heart, even a more direct impulse may be felt. As this *epigastric pulsation* is always important, it should be sought for, not only by placing the flat of the hand over the pit of the stomach, but also by inserting the tips of the fingers under the costal cartilages in the direction of the heart. This epigastric pulsation from the action of the heart must be distinguished from a pulsation communicated from the aorta, which is felt under certain conditions in the same region. The aortic pulsation can usually be traced along the vessel in the abdomen, not merely as a pulsating tumor, and, by careful attention to its rhythm, it will be found to succeed the cardiac systole. This "throbbing aorta" is a frequent fact in anæmic or nervous conditions (see p. 263). Aneurism of the abdominal aorta, or of some of its branches, may also give rise to pulsation in the epigastrium, but other signs will usually guide the diagnosis.

When the base of the heart is uncovered, owing to retraction of the edge of the left lung, as in phthisis pulmonalis, the roots of the great vessels, and especially of the pulmonary artery, as it is most superficial, are exposed, and as it usually happens in such cases that the patient is much emaciated, a pulsation which corresponds with the expansion of the pulmonary artery can sometimes be felt and even seen. It is situated about the third left intercostal space, near the margin of the sternum, is very restricted in its area, and, in addition to the impulse, the finger is conscious of its being succeeded by a snap and sudden recoil, coincident with the closure of the sigmoid valves. In rare instances, pulsation from the auricle exists in this situation, but the impulse in such a case precedes the apex-beat, and is succeeded by no snap. Simultaneous tracings of the cardiac apex-beat and the abnormal pulsation in such cases may be taken with the cardiograph, and will at once resolve any difficulties that may arise as to its being due to auricle or pulmonary artery. The aorta is too deeply seated to give any definite impulse externally in the normal conditions, but when aneurismal disease of its thoracic portion exists a pulsation may be produced which can, as a rule, be quite easily separated from that of the heart (see p. 475).

Pulsation in the vessels of the neck. The jugular fossa should be explored by inserting the tips of the fingers down behind the sternum, the patient being directed to bend the head forwards, so as to relax the tissues. Undue pulsation somtimes associated with the sense of resistance or tumor, chiefly due to aneurism, is often met with in this situation. The trachea may be found displaced somewhat backward, or to either side in such cases. The state of the jugular veins is also to be noted, pulsation in them being a frequent associate of valvular diseases of the right side of the heart. Such pulsation, however, is not necessarily a morbid fact; it merely indicates regurgitation of blood back into the veins, the valves at the root of the neck being incompetent. This may occur in perfect health, though usually only in a slight degree, without any distension or other abnormal symptom, from the impulse of the auricle (perhaps also of the right ventricle) being transmitted directly through congenitally imperfect valvular mechanism, which is productive of no sensible inconvenience. In some instances, although there is no actual pulsation in the vein, it receives a movement from the artery lying underneath it, so as to simulate this: the way to solve the difficulty is by pressing very lightly on the vein at the root of the neck, and so occluding it, and if under these circumstances the pulsation ceases, the inference is that the action is in the vein, while if it continues it is most probably due to the heave of the carotid. The pulsation also in the veins of the neck can usually be recognized as different in character from a transmitted arterial impulse, being, as a rule, much more wavy. Retraction of the veins of the neck during the cardiac diastole should be looked for, as it is said to occur sometimes in cases of adherent pericardium. Undue pulsation in the arteries of the neck exists in exophthalmic goitre, in some cases of anæmic palpitation, and in aortic insufficiency, where the visible pulsation is often a very marked feature.

CHANGES IN THE AREA OF PRECORDIAL DULNESS.

The area of precordial dulness may be increased, diminished, or displaced. *Decrease* in its area is generally due, not to disease of the heart itself, but to changes in the lungs, and especially to emphysema, in which the anterior margins of the lung may become so distended as to mask the cardiac dulness to a greater or less extent. (See Fig. 84, p. 486.) In emaciating diseases, however, the heart participates in the general atrophy, and this may lead to some decrease in the precordial dulness.

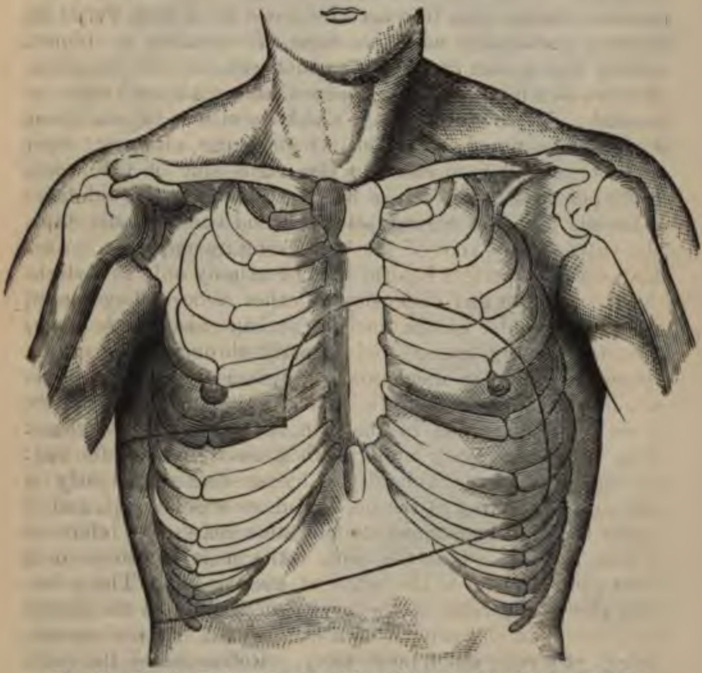

Fig. 70.—Cardiac Dulness increased from Hypertrophy of both ventricles.

But *increase* in this area is much more frequent. If the increase is towards the left side and downwards, and coincides with a strong and somewhat diffused apex-beat in the sixth or seventh interspace, or much to the left of its normal site, it most likely indicates hypertrophy of the left ventricle. If on the other hand, the dulness extends chiefly to the right, the presumption is that the right ventricle is the seat of hypertrophy or dilatation, and this may be corroborated by the occurrence of a well marked heaving action over the right ventricle, by an ill-defined apex-beat, and by the presence of pulsation in the epigastrium. If the dulness is increased pretty equally both to right and left, while the upper margin maintains its normal position, hypertrophy or dilatation of both cavities may be suspected (see Fig. 70); but if with lateral extension there is a conical prolongation of the dulness up in the direction of the first rib, there is ground for suspecting effusion into the pericardium. (See Fig. 71.) In all these cases there may be a degree of vaulting in the precordial region, but it is usually most marked in pericardial effusion, in which the percussion resistance is also greatly increased. Apparent increase in the dulness may arise from tumors, aneurismal, cancerous, or glandular, situated in the mediastinum, or from effusions into the pleuræ, or even from limited consolidations of the lung in the immediate vicinity of the heart. The diagnosis of aneurism may be made from the fact that the abnormal area of dull percussion is usually situated at the base of the heart, often under the manubrium sterni; it coincides in situation with the aorta, and is sometimes joined to the cardiac dulness by only a narrow neck; a pulsation separable from that of the heart is often present over it, sometimes accompanied with thrill, and the heart's sounds are often changed in quality over the dull area, and sometimes associated with murmur. The diagnosis in the other conditions mentioned may be assisted by the fact that the cardiac sounds are normal in character, not coextensive with

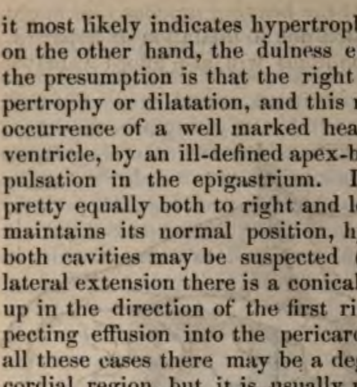

Fig. 71.—*Percussion-dulness in Pericardial Effusion:* the lower and left margins are undefined, owing to their being inseparable from the dull percussion of the abdomen and of the left pleura. (Gairdner.)

the dull area and there is not the heaving impulse that might be expected were the extension due to dilatation or hypertrophy of the heart itself. Symptoms will also afford valuable means of diagnosis.

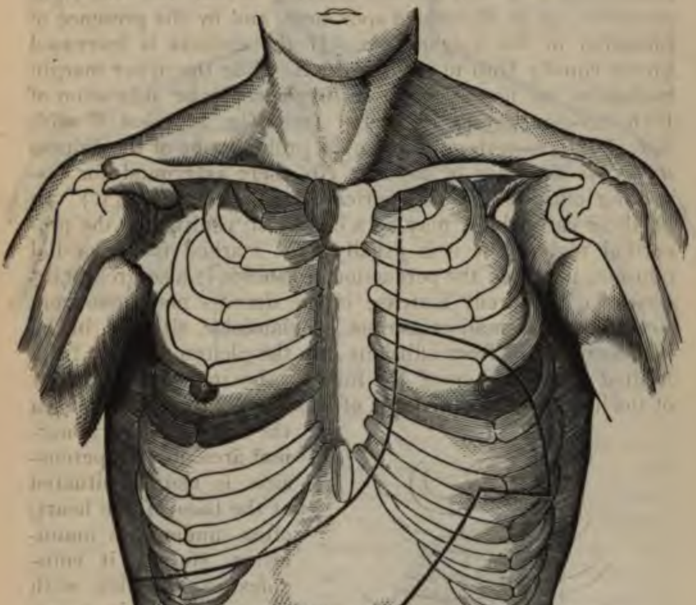

Fig. 72.—Displacement of mediastinum, heart, and liver from pneumothorax of the right side. (Weil.)

Displacement of the area of cardiac dulness either to the right or left may be due to pleural effusions of fluid or air, the displacement being always most marked when the left pleura is the seat of the disease. (See Figs. 72 and 73.) Tumors in the thorax may displace the precordial dulness in almost any direction. A certain amount of displacement of the cardiac dulness is of habitual occurrence in emphysema of the lung, associated usually with some diminution of its extent also. (See Fig. 84, p. 486.)

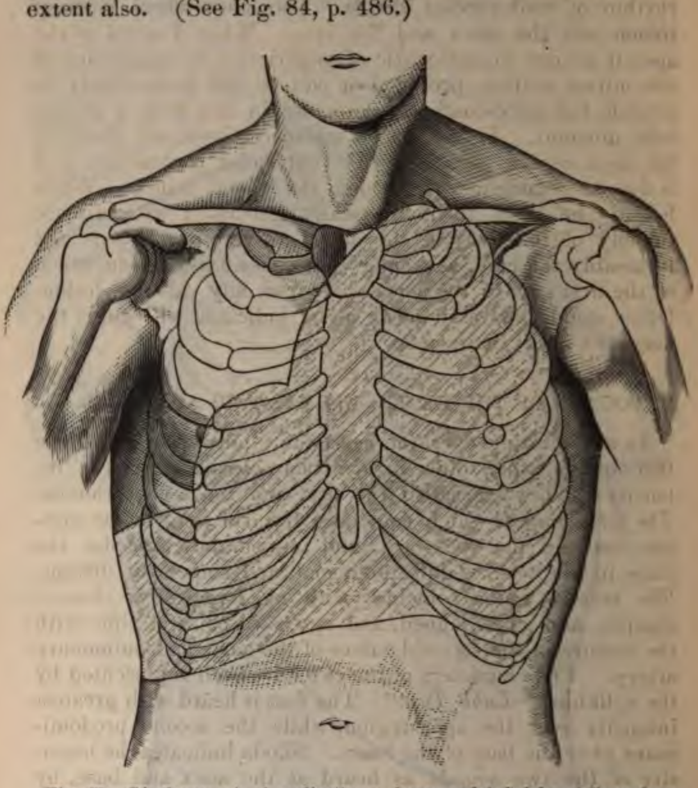

Fig. 73.—Displacement of mediastinum, heart, and left lobe of liver from pleuritic effusion on the left side: the shading indicates the extent of dull percussion.

CARDIAC TREMOR OR THRILL.

In the palpation of the heart there is sometimes conveyed to the hand along with the impulse a sense of tremor or thrill—"purring tremor." It is most frequently associated with valvular disease either aortic or mitral, and is quite distinct in its production from the sensation which is sometimes felt over the precordial region in pericarditis, from the rubbing of the r[illegible]d peric[illegible]aces on each other.

This latter, when typical, has a rubbing, grating character, and does not as a rule possess the fixity as regards site and rhythm of endocardial thrills. The most usual sites of tremor are the apex and the base. When limited to the apex it is very characteristic of constriction or roughening of the mitral orifice, provided it can be felt immediately to precede the apex-beat. It coincides in fact with a presystolic murmur. In not a few instances, however, thrill in the apex-region coincides with ventricular contraction, and is due to regurgitation through the mitral orifice. When felt at the base, thrill is usually associated with disease (chiefly obstructive) of the aortic valves, but this is not invariably the case, as tremor sometimes exists in aneurism of the first part of the aorta apart from any valvular lesion. Other conditions afterwards to be indicated will guide the diagnosis in all these cases.

SOUNDS OF THE HEART, NORMAL AND ABNORMAL.

In auscultating over the heart the student will recognize two sounds which differ in their characters and sites of intensity. They are called the first and the second sounds. *The first sound*, which coincides with the ventricular contraction and the apex-beat, and immediately precedes the pulse in the neck, is dull, prolonged, and somewhat distant. *The second sound* coincides with no impulse, is clearer, sharper, and more defined, and agrees in point of time with the closure of the sigmoid valves of the aorta and pulmonary artery. The characters of the two have been represented by the syllables "*Lubb Tup.*" The first is heard with greatest intensity over the apex-region, while the second predominates over the base of the heart. Skoda indicates the intensity of the two sounds as heard at the apex and base, by saying that at the apex they form a Trochee—lūbb tŭp—and at the base an Iambus—lŭbb tūp. In a slowly acting heart there is usually no difficulty in distinguishing the sounds, which are defined not only by the characters above indicated, but also by the fact that the interval between the first sound and the second is much shorter than that between the second and the first, the diastole or long pause of the heart as it is called intervening. The following diagram (Fig. 74), indicates approximately the relations which the various periods in a complete cardiac revolution bear to each other. When, however, the heart is acting rapidly the increase is chiefly at the expense of the long pause, and then it may be a matter of difficulty to determine which is the first and which is the second sound; and this all the more so if either sound is so altered in character as to approximate to its fellow. The double stethoscope will, as a rule, however, resolve this doubt, the one bell being placed over the apex and the other over the base.

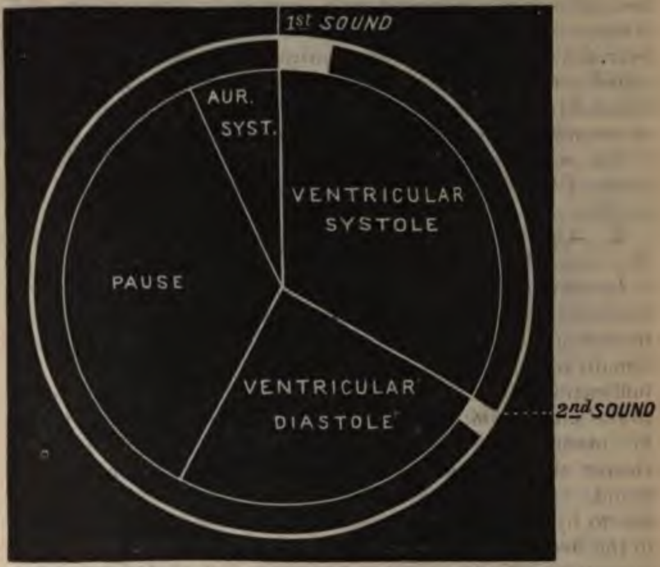

Fig. 74.—Diagram of heart's Action.[1] (Gairdner.)

Both sounds are complex inasmuch as the first coincides with the contraction of the two ventricles and the second with the closure of the sigmoid valves of the aorta and pulmonary artery. That part of the first sound due to the left ventricle is heard with greatest distinctness in the apex-region, while that from the right side of the heart is most intense over the right ventricle near the sternum. The aortic element of the second sound is best communicated to a point at the junction of the second right costal cartilage with the sternum, this being often called the "aortic cartilage." The pulmonic second sound is best heard near the junction of the third left costal cartilage with the sternum. In health, as a rule, the sounds at the apex and aorta predominate over those of the right side of the heart. Some assistance is also obtained from considering the relative intensity, in various circumstances, of the sounds as heard over the carotid and subclavian arteries, where the second sound may usually be regarded as identical with that produced by the closure of the aortic valves. But much care is necessary in founding conclusions on the above data.

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[1] This figure is retained (after considerable investigation) without serious modification: it represents in a diagramatic form the relation of the different portions of a cardiac revolution to each other: but it does not aim at accuracy as regards the exact duration of the sounds, which are not as yet capable of being measured with precision.

The sounds of the heart may become (1) altered in character; (2) reduplicated; (3) associated with or replaced by murmurs.

I. ALTERATIONS IN CHARACTER OF THE HEART'S SOUNDS.—In many exhausting diseases the sounds are apt to become *feeble*, and in the later stages of certain fevers, notably typhus, the first sound is especially weakened, and in extreme cases almost suppressed, while the second may remain tolerably clear and distinct. Fatty degeneration or infiltration of the muscular fibre of the heart naturally leads to the same result. In dilatation also the first sound fails in intensity and duration, and in some cases it becomes clearer than normal, approaching the quality of the second sound. *Strengthening of the cardiac sounds* is, as a rule, due to hypertrophy. This is especially the case with regard to the first, which becomes dull, prolonged, and booming in character. If this change is most marked in the apex-region, the presumption is that the left ventricle is hypertrophied, while if it is present over the right ventricle it usually points to that cavity as the seat of the change. In each case the second sound is unduly accentuated, the alteration being recognizable as over the aorta or pulmonary artery, according to the cause of it. But the second sound may be accentuated and deepened in tone, becoming "clunking" in fact, apart from hypertrophy of the ventricles. This may be present over the aortic cartilage in cases of high arterial tension in the systemic circulation, or in dilatation of the arch of the aorta, or when the aorta has lost its elasticity from degenerative changes. In all such cases the deepened tone is usually transmitted into the vessels in the neck. Over the pulmonary artery the second sound is accentuated in conditions which present an obstacle to the free passage of blood through the lungs. This change is met with in pneumonia, and is often a marked feature in cases of obstruction or regurgitation at the mitral orifice. In certain cases, as in retraction of the upper lobe of the left lung from phthisis, the second pulmonic sound may appear to be morbidly accentuated when in reality it is simply brought near the ear by having lost its covering of lung. In most of these instances, however, pulsation, both visible and tangible, is present over the artery, and the snap of the closure of the valve is often communicated to the hand. These conditions will help to guide the diagnosis. (See p. 455.)

When large air-filled cavities are in close proximity to the heart the sounds may take on a hollow, ringing, metallic quality of the nature of an echo. The first sound is most frequently so affected, the causes being large pulmonary cavities, pneumothorax, or an over-distended stomach.

II. REDUPLICATION OF THE HEART'S SOUNDS arises from a splitting up of one or other sound into its component elements. Either sound may be reduplicated, and there is then produced a galloping or cantering action indicated by the syllables "*rat-ta-tat.*" The clinical significance of this fact is not very clear. It occurs at times in healthy subjects: and it will be sufficient for the student to note that, if it is best heard anywhere over the ventricular area, it is probably the first sound which is resolved into its component elements, while, if over the base, it is the second. Any condition which increases the tension either in the systemic or pulmonic circulation may predispose to reduplication. It is certainly a frequent fact in cases of Bright's disease, especially in the granular form (chronic Bright's disease), but it is also not infrequent in the acute disorder. Reduplication may be complete, with the two elements of the sound quite distinct; or incomplete, where there is no distinct interval, the sound appearing only lengthened and slurred ("*turrup*").

III. CARDIAC MURMURS.—The sounds of the heart may be associated with or replaced by murmurs. The two most important facts to determine about these are (A) Their Rhythm, and (B) Their Site, or Area of distribution. As the great majority of murmurs are valvular in origin, it is on the whole a good rule to try all murmurs which require detailed investig [illegible] he tests [illegible] lvular murmurs before proceedin [illegible] r.

A.—RHYTHM OF CARDIAC MURMURS.

What has to be considered under this head is the relation of a murmur to the different physiological acts which constitute a complete cardiac revolution, viz., the contraction, dilatation, and rest of each of the cavities (see Fig. 74, p. 462). The murmur has to be defined as occurring during this or that portion of the heart's action, or during the pause which intervenes between the periods of activity. To do this it is necessary to watch carefully its relation to the normal sounds, to the impulse, and to all the other appreciable phenomena which attend upon the action of the heart.

All valvular murmurs (apart from those of complex origin) have one of three relations to the sounds and impulse of the heart.

(1) *The murmur precedes and runs up to the first sound*, ending at the moment of this sound and of the beat of the apex. In this case the murmur is synchronous with the contraction of the auricles, and is called *Auricular-Systolic*,[1] or by some *Presystolic* (from its preceding the systole of the ventricle). The interpretation of such a murmur depends on its *occurring only when blood is being expelled from an auricle*, and when the ventricle is still passive. With very rare exceptions such a murmur depends upon constriction of the auriculo-ventricular orifices and consequent interruption to the flow of blood out of the auricle during its contraction. It is thus said to be a *direct* or *onward* murmur, and is usually very rough in character, and often accompanied by a thrill (see p. 459).

The Auricular-Systolic murmur may merely precede the first sound, *i. e.*, it may follow the pause of the heart's action, or it may appear to be prolonged out of or even quite through it, the period of rest being in this last case necessarily associated with a degree of the ventricular-diastolic murmur presently to be described (below). Its essential character, however, is preserved in every case as above defined and as represented in the diagram (Fig. 75). For the sake of brevity it is sometimes named "A.S." (Auricular-Systolic).

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[1] The terms here applied to murmurs, viz., "Auricular-Systolic" (A. S.), "Ventricular-Systolic" (V. S.), and "Ventricular-Diastolic" (V. D.), have become the habitual nomenclature in the Glasgow School, and what is meant by calling a murmur, a thrill, or other phenomenon, "A. S.," "V. S.," or "V. D.," is that it coincides in point of rhythm or time with one or other of the periods of the heart's action, which is thus exactly expressed (see Fig. 74). The period of auricular systole had no definite place assigned to it in any scheme prior to Dr. Gairdner's; the old term "Presystolic," as applied to a murmur, being vague and giving no hint as to its coincidence with the systole of the auricle. The terms can be applied to all kinds of murmurs, indicating as they do simply the exact rhythm apart from any considerations of causation.

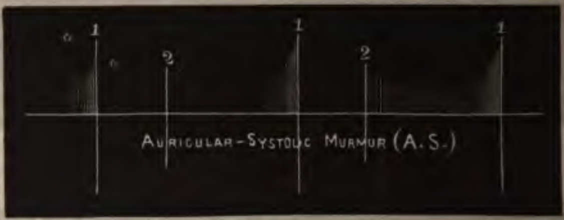

Fig. 75. (Gairdner.)

(2) *The murmur follows and runs off from the first sound*, ending somewhere between the first and the second, or close to the second sound. In this case the murmur is synchronous with the contraction of the ventricles, and may be called ***ventricular-systolic***. A ventricular-systolic murmur, being coincident with the emptying of the ventricles, must of course be caused (if valvular in origin) *by blood flowing outward from the ventricle*, either in the natural outward direction (over a roughened aortic orifice, for example), or backward by regurgitation through the auriculo-ventricular orifices. When due to obstruction at the arterial orifices it is said to be a *direct* murmur, but when caused by regurgitation through the auriculo-ventricular valves, it is named *indirect* or *backward*. It may be indicated diagrammatically, as in Fig. 76. "V.S." is the contracted designation for this murmur (Ventricular-Systolic).

(3) *The murmur follows and runs off from the second sound*, ending somewhere during the interval between the second sound and the first. In this case the murmur is simultaneous with the dilatation of the ventricles, and may be called *Ventricular-Diastolic*, and may be represented as in Fig. 77. A "ventricular-diastolic" murmur is *coincident with the filling of the ventricles by their rapid expansion-movement*. It is always due, therefore (if valvular), to blood entering a ventricle, either from the auricles or from the arterial orifices, and in this last case, of course, the semilunar

valves must be deficient so as to admit of the regurgitation. This is the "V.D." (Ventricular-Diastolic) murmur.

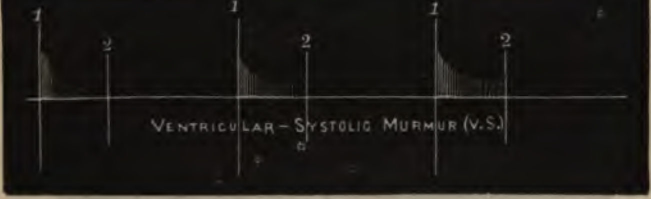

Fig. 76. (Gairdner.)

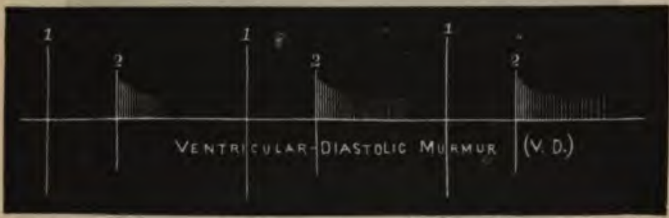

Fig. 77. (Gairdner.)

Various combinations of these different murmurs occur not unfrequently, and this renders the diagnosis so much the more perplexing. For instance, it is not unusual to have an "*auricular-systolic and a ventricular-systolic*" (A.S. + V.S.) murmur combined (as in Fig. 78), and they may even appear to be so combined as to constitute but one murmur. Commonly, however, the first sound can be detected in the middle of this murmur, splitting it, as it were, into two. All that precedes the sound is "*auricular*-systolic," and all that succeeds it is "*ventricular*-systolic." In like manner, a "*ventricular-systolic" and a "ventricular-diastolic*" (V.S. + V.D) murmur are very frequently combined (in cases of aortic obstruction and re-

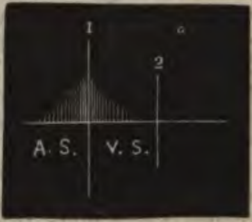

Fig. 78.—Auricular-Systolic and Ventricular-Systolic murmurs combined. (Gairdner.)

gurgitation), but here the second sound intervenes and makes the rhythym quite plain (see Fig. 79). The greatest degree of difficulty arises when the sound is merged in the murmur, as it often is, when an "auricular-systolic" and a "ventricular-systolic" are combined, but even in such a case it is often found that the first part of the murmur is very rough, and the second part has often more of a blowing character.

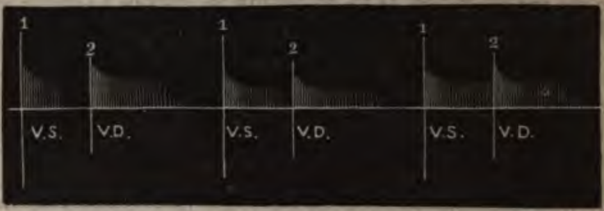

Fig. 79.—Ventricular-Systolic and Ventricular-Diastolic murmurs combined. (Gairdner.)

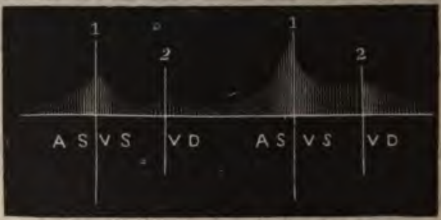

Fig. 80.—Auricular-Systolic, Ventricular-Systolic and Ventricular-Diastolic murmurs combined. (Gairdner.)

The murmur will often, in fact, abruptly change its character about the moment of the apex-beat, and we may find that one element of the complete murmur is heard more clearly at the apex, and the other at the base, or elsewhere. A very complex association of murmurs is found when all the periods of the heart's movement are accompanied by murmur, extending even through the period of rest. This is represented in Fig. 80. (A.S. + V.S. + V.D.)

B.—AREA OF CARDIAC MURMURS.

Having determined the rhythm of a murmur, the next step in the investigation is to fix within as narrow limits as possible the place of its origin.

The point at which a murmur is produced being in the majority of cases one of the four valvular orifices, it is commonly desirable to test all murmurs on the supposition that they are valvular. The first branch of the inquiry as to the seat of origin of a murmur is therefore commonly this: *at which of the four valvular orifices is it produced?* As there are four valvular orifices, so there are four distinctive areas to which murmurs arising at these orifices may be propagated. The following rules will be found useful in recognizing these areas:

(1) *Area of the mitral murmur.* The mitral murmur corresponds generally with the apex of the left ventricle. To find this area with precision it is necessary to have determined all the points about the apex-beat insisted on in the earlier part of the physical examination. If a murmur concurs in position with the apex-beat, and if its seat of diffusion is round this point nearly in a circle (see Fig. 81, area marked A.); or even, and more especially, when the murmur is communicated more intensely and immediately to the left than to the right of the apex, as ascertained by the impulse, it is probably of mitral origin. Mitral murmurs are often heard over a very limited space in front of the thorax; they are mostly inaudible at the base of the heart: but, on the other hand, they are frequently conveyed with great distinctness to the back of the chest, about the lower angle of the left scapula. They are usually either "auricular-systolic" or "ventricular-systolic," the former being sometimes associated with a "ventricular-diastolic" portion, and various combinations of these occur.

Naunyn has asserted that the murmur of mitral regurgitation may have its seat of intensity, not in the mitral area, as above described, but in the second interspace, one and a half or more inches to the left of the edge of the sternum, and that it is communicated to this point from the left auricle which crops up on the outer side of the pulmonary artery. He attributes this distribution of it to the better conduction of the murmur along the course of the regurgitating blood, and to the fact that, owing to its dilated condition, the left auricle comes nearer to the surface. Paul Niemeyer,

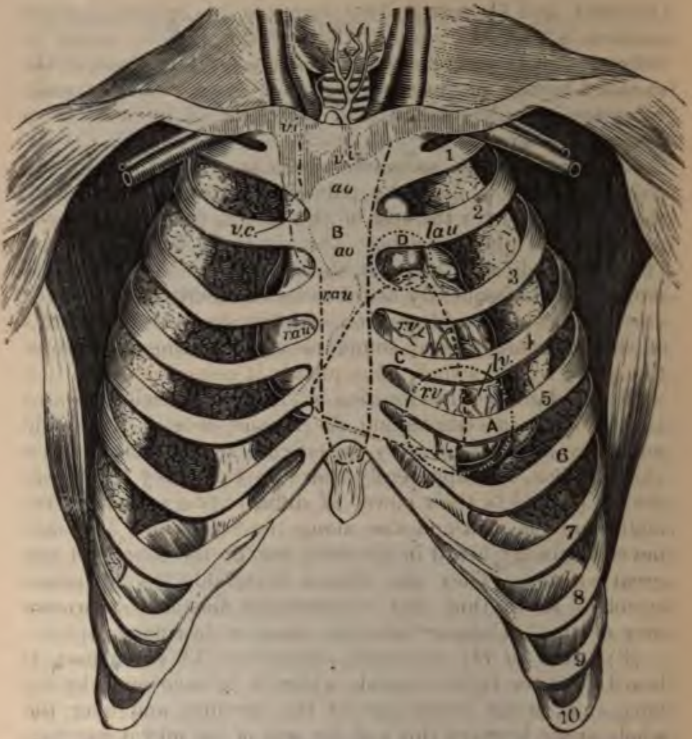

Fig. 81.—*Areas of Cardiac Murmurs* (Gairdner for the areas: and Luschka for the anatomy). The outlines of organs, which are partially invisible in the dissection, are indicated by very fine dotted lines: while the areas of propagation of valvular murmurs, as described in the text, have been roughly marked by additional much coarser and more visible dotted lines,—the character of the dots being different in each of the four areas. A capital letter marks each area, viz., A, the circle of mitral murmur corresponding with the left apex: B, the irregular space indicating the ordinary limits of diffusion of aortic murmurs, corresponding mainly with the whole sternum, and extending into the neck along the course of the arteries: C, the broad and somewhat diffused area occupied by tricuspid murmurs, and corresponding generally with the right ventricle: D, the circumscribed circular area over which pulmonic murmurs are commonly heard loudest.

Reference letters:—r. au. = right auricle; a. o. = arch of aorta; v. l. = the two innominate veins; v. c. = vena cava descendens; p. = pulmonary artery; l. au. = left auricle: l. v. = left ventricle; r. v. = right ventricle.

Gerhardt, and George Balfour concur in this opinion, but the question is still *sub judice*. Dr. George Balfour seems to indicate that in anæmic and chlorotic conditions many of the so-called hæmic murmurs referred to the area of the pulmonic valve are in reality mitral, and their seat of intensity is as described above.

(2) *Area of the pulmonic murmur.* Murmurs in the pulmonary artery, or at the pulmonic valves, are carried to the ear nearly over the seat of the valves, or over the upper part of the right ventricle. The circle D in the diagram (Fig. 81) indicates the most elevated position of the murmur, but it is frequently heard more distinctly a little lower down. It coincides in position with the greatest distinctness of the pulmonic second sound as contradistinguished from the aortic second sound. Frequently it coincides in position with a certain tactile vibration or snap, as described above (see p. 455), accompanying the second sound. Pulmonic murmurs are usually very superficial, and therefore often very distinct, and apparently near the ear; they are nevertheless limited in their power of diffusion, being usually inaudible at the apex and also along the sternum. They are never distinctly heard in the neck nor in the course of the great vessels. They are almost invariably "ventricular-systolic" in rhythm, but "ventricular-diastolic" murmurs may occur. (Compare also last clause of last paragraph.)

(3) *Area of the tricuspid murmur.* This murmur is heard over the right ventricle where it is uncovered by the lung, *i. e.*, at the lower part of the sternum, and over the whole space between this and the seat of the mitral murmur. It is usually very distinct and superficial in its character, little audible, however, above the third rib, and thus distinguished both from the pulmonic, and still more from the aortic murmur. Its area in ordinary circumstances is indicated by the triangular space marked C. in Fig. 81, but in cases of considerable hypertrophy and dilatation of the right side of the heart, especially in connection with emphysema, the murmur is heard loudest towards the xiphoid and along the margin of the sixth or seventh left costal cartilage. The rhythm is usually "ventricular-systolic," but in rare instances it may be "auricular-systolic."

(4) *Area of the aortic murmur.* This murmur is found not only in great intensity over the base of the heart and the manubrium sterni, which are in the immediate vicinity of the seat of its production, but frequently, and not less

distinctly, along the whole line of the sternum; rather oftener than otherwise, it is absolutely louder close to the xiphoid than at many points nearer to its origin. This is specially true of the diastolic murmur (V. D.). The aortic murmur is distinguished from all the other valvular murmurs by being propogated into the arteries of the neck. This is especially true of the obstructive murmur, which is usually transmitted with considerable intensity; the regurgitant, however, may be very faint and almost inaudible there. The aortic murmur has often a special distinctness over the sternal end of the second right costal cartilage ("aortic cartilage"). It is the most widely-diffused of all the cardiac murmurs, and can sometimes be traced to great distances along the spine, and even into the extremities. The area marked B, in Fig. 81, indicates the seat of distribution of the aortic murmur. The murmur may be "ventricular-systolic" or "ventricular-diastolic," usually they are combined.

PERICARDIAL MURMURS are frequently present with both sounds of the heart, and when present with only one it is almost invariably the first. They are to be distinguished in part by their special acoustic character of friction, grating, or shuffling. In general terms they may be said to be deficient in precision of rhythm, and especially in what may be termed accentuation. They are liable to change both in rhythm and position from time to time. They are more considerably altered as to character and intensity by the position of the patient than endocardial murmurs, and they are also more considerably and especially more essentially altered in their character by pressure with the stethoscope. They are sometimes heard along the left margin of the heart or at the apex, but on the whole they most frequently occur over the right ventricle and at the mid-sternum, and are not carried into the arteries of the neck, or in the direction of the xiphoid cartilage.

Pericardial murmur may be simulated by friction sound in the pleura on the borders of the heart. As a rule, the friction obeys the respiratory rhythm and ceases when the breath is held, but in some instances the friction, though due to roughening of the pleura, is dominated by the cardiac movements. The distribution of the friction, the absence of symptoms of cardiac derangement, and perhaps the presence of other signs of pleurisy, may guide the diagnosis.

TABULAR VIEW OF CARDIAC VALVULAR MURMURS.

A. DETERMINE THE RHYTHM. B. DETERMINE THE SITE, OR AREA OF DISTRIBUTION.

Rhythm of Murmur	Causes of Murmur having such a Rhythm.	Diagnosis from Rhythm and Area combined.
Before first sound (A.S.).	OBSTRUCTION at the (1) right or (2) left auriculo-ventricular orifice.	If in *mitral* area = OBSTRUCTION OF MITRAL ORIFICE. If in *tricuspid* area = OBSTRUCTION OF TRICUSPID ORIFICE (very rare).
After first sound (V.S.).	OBSTRUCTION (1) at the orifice of the aorta, or (2) the orifice of the pulmonary artery.	If in *aortic* area = AORTIC OBSTRUCTION. If in *pulmonic* area = PULMONIC OBSTRUCTION (very rare).
	REGURGITATION (3) through mitral orifice, or (4) through tricuspid orifice.	If in *mitral* area = MITRAL REGURGITATION. If in *tricuspid* area = TRICUSPID REGURGITATION.
After second sound (V.D.).	REGURGITATION (1) through aortic semilunar valves or (2) through pulmonic semilunar valves.	If in *aortic* area = AORTIC REGURGITATION. If in *pulmonic* area = PULMONIC REGURGITATION (very rare).
After second sound and running up to first (V.D.+A.S.).	(1) OBSTRUCTION at auriculo-ventricular orifices.	If in *mitral* area = MITRAL OBSTRUCTION. If in *tricuspid* area = TRICUSPID OBSTRUCTION.
	(2) *Combination* of OBSTRUCTION at one or other auriculo-ventricular orifice (A.S. element), and REGURGITATION through the aortic or pulmonic valves (V.D. element).	If the *two elements of the murmur have separate areas*, e.g., *mitral* and *aortic*, this indicates MITRAL OBSTRUCTION AND AORTIC REGURGITATION.

MURMURS DUE TO ANEURISMS OF THE ARCH OF THE AORTA, especially of the ascending part, are with difficulty distinguished from those of aortic valvular disease. Sometimes the distinction is impossible, or can only be arrived at through the superadded signs of aneurism. (See p. 475.) Such murmurs are usually ventricular-systolic (V.S.) in rhythm.

ANÆMIC AND FUNCTIONAL MURMURS (SO CALLED HÆMIC), as heard over the heart and great vessels, are always ventricular-systolic (V.S.) in rhythm, and they almost always simulate aortic or pulmonic murmurs as regards their area, but in rarer instances mitral. They are to be distinguished chiefly from murmurs of organic origin by the circumstances in which they occur, and by the absence of symptoms of valvular disease.

A METALLIC ECHO OF ONE OR BOTH CARDIAC SOUNDS may simulate a murmur and may be produced by an air filled cavity in the neighborhood of the heart (tubercular cavity in the lung, pneumothorax, and the stomach). It is distinguished by its peculiar hollow, ringing, or booming quality. Reduplication of a sound is apt in some cases to simulate a murmur, especially when the reduplication is incomplete, but attention to details will minimize this difficulty.

MURMURS IN THE ARTERIES. In almost all the large arterial trunks a murmur ventricular-systolic (V.S.[1]) in rhythm may be evoked by pressure with the stethoscope. Apart from this pressure, however, such a murmur is often present in the subclavian arteries, more especially on the left side, and that without any lesion at the aortic orifice. It may be present in anæmic conditions, but is not uncommon in apparently healthy subjects. If however there is a double murmur (V.S. and V.D.) at the aortic orifice, the first of these is invariably carried into the vessels of the neck with considerable intensity, and in not a few instances the second is propagated in a similar direction though much less distinctly. Duroziez pointed out that in certain diseased conditions, especially in aortic insufficiency, pressure educed not only a systolic but also a diastolic murmur in the arteries chiefly in the femorals, but it has also been found apart from any disease of the vascular apparatus.

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[1] Strictly speaking, and with reference to absolute accuracy indeed, the rhythm of an arterial murmur cannot be indicated in terms of cardiac derivation at all; the exact time of the arterial murmur produced by the contraction of the ventricles, and the onward current in the vessels being by so much later than the ventricular systole, as the vessel is remote from the heart. A more strictly accurate nomenclature, therefore, would be to call an arterial murmur, such as is here indicated, *arterial-diastolic, i. e.*, coincident in time with the expansion, diastole, or pulse of the individual artery examined. In some cases the postponement of the arterial murmur to the cardiac impulse is easily verified, and the above term is not only apposite and convenient but of practical importance.

MURMURS IN THE VEINS may also be present, especially in the large trunks at the root of the neck. They are humming or musical in quality, and are continuous, and thus easily differentiated from arterial murmurs in the same locality, which intermit with the cardiac action. This *venous hum* (humming-top sound or *Bruit de Diable*) is often associated with impoverished states of the blood (anæmia, chlorosis, &c.), but does not necessarily indicate disease. The position of the patient is apt to influence both the intensity and quality of these murmurs, the erect posture generally rendering them louder and more musical: inspiration has a similar effect. They are said occasionally to intermit.

THORACIC ANEURISM.

Incidental allusions have been made in the preceding pages to aneurism of the thoracic aorta and its branches, but it may be well to indicate a little more in detail points to which attention should be given in the investigation of this subject. The position of an aneurism will vary according to the portion of the vessel involved. It may impinge on the thoracic wall in the immediate neighborhood of the heart or at almost any point in the upper part of the thorax, and aneurisms of the innominate branch of the aorta may even reach high up into the neck. A very frequent seat of thoracic aneurism is under the manubrium sterni. Aneurisms of the ascending arch are said to pass chiefly to the right of the sternum, those of the transverse arch, lie as a rule under the manubrium, while those of the descending arch tend to the left side. No fixed rules can be laid down however; in some instances the pressure signs and symptoms may aid us in determining the portion involved.

Aneurism in the thorax often causes a local *bulging of the chest wall*, and when looked at in a cross light this bulging may be seen to pulsate, while palpation at once detects the heaving action. If the aneurism has by its pressure eroded any portion of the bony structure it may present itself as a distinct *pulsating tumor*, the impulse being separable from that of the heart both by position and rhythm (the cardiac impulse preceding that of the aneurism by an instant), and if the tumor is grasped by its periphery between the fingers, the *pulsation is found to be expansile or eccentric*, and this is a very valuable diagnostic point from glandular tumors, cancerous growths, abscesses, &c., in the mediastinum, which may simulate aneurism by having the heave of the aorta communicated to them. In rare instances the aneurism may yield a double impulse, a systolic and a diastolic; the latter, or "impulse of arrest," as it is sometimes called, being generally slight when present at all. A distinct *thrill* is also occasionally felt, most frequently in aneurisms near the heart. Along with these signs there will be an *area of dull percussion*, which, according to the size and position of the aneurism, may be separable from the cardiac dulness, joined to it by a more or less narrow neck, or quite continuous with it.

In many instances, however, no distinct pulsating tumor is present, although there may be an obscure heave, and the only definite physical signs are an area of percussion-dulness, more or less marked, in the track of the aorta, and certain auscultatory phenomena to be mentioned immediately. Sometimes, indeed, even these signs are wanting or very obscure, and the diagnosis may rest almost entirely on other signs and symptoms, such as fixed pain, dyspnœa, hæmoptysis, signs of pressure on nerves and veins, displacements of the trachea, backwards or to either side, sense of fulness in the jugular fossa, changes in the pupils, pulses, &c. (see Chapter ix.).

The *auscultatory signs* may vary. In some instances, especially where the tumor involves the first part of the ascending arch, murmurs following both sounds (V.S. and V.D.) may be present, owing to implication of the aortic valves. But independent of any such condition, murmurs may be found in aneurisms in any part of the thorax, the rhythm being usually "ventricular-systolic," or, more correctly, arterial-diastolic, as it corresponds with the expansion of the artery. In many instances, however, no murmur is present, but the cardiac sounds may have undergone alteration, as heard over the suspected area. Both sounds may have become very distinct, sometimes even more so than over the cardiac region; the second is especially apt to be accentuated, and even develops a different quality, becoming deepened in tone or "booming," and this character is transmitted into the vessels of the neck. This mere change in the second sound would not warrant any diagnosis of aneurism, as there are other conditions which induce it (see p.

463). In aneurismal conditions it is sometimes wanting, but when present with symptoms such as are indicated above and accompanied by an area of dull percussion in the line of the aorta, the presumption of aneurism becomes very strong.

Simple dilatation of the arch of the aorta may give rise to varying degrees of percussion-dulness, chiefly in the region of the manubrium sterni. There is, as a rule, no visible or tangible impulse over this area; but if the finger is inserted into the jugular fossa, the dilated vessel may be easily felt, and its impulse recognized. The second sound is usually accentuated and booming, but pressure symptoms are as a rule absent.

Signs of aneurism may present themselves in the back of the thorax. Percussion-dulness of limited area, and close to the left side of the spine, with changes in the cardiac sounds and symptoms of pressure, as already indicated, have to be chiefly relied on. Indeed, in many such cases physical examination may yield little information, and the diagnosis may depend chiefly on the symptoms.

The conditions most likely to simulate aneurism are visible and tangible pulsation from the pulmonary artery or left auricle, about the second left intercostal space (for diagnosis see p. 455), pulsating empyema, and cancerous tumors. Pulsating empyema usually occupies the normal situation of the heart, which is found displaced to the right, and communicates its impulse to the fluid collection. There is as a rule a distinct history of a pleuritic attack, and it is unattended by murmur, thrill, or alteration in the cardiac sounds. Pulsating cancer may present more difficulty, as it may be attended by murmur, and give rise to all the pressure symptoms already indicated. But careful palpation may detect that the pulsation is not so distinctly expansile as in aneurism, nor does the centre of pulsation correspond to that of dulness. The glands in the neighborhood that are accessible may be discovered enlarged, the cachexia may be well marked, and the sounds of the heart over the dull area, except in so far as attended by murmur, do not present the alterations so often found in aneurismal conditions.

PART III.—PHYSICAL EXAMINATION OF THE ABDOMEN.

Anatomists have divided the abdomen into various regions by lines drawn from certain fixed points, viz., two horizontal lines passing across the body, the one at the lowest points of the costal arch, and the other at the highest part of the iliac crests: two vertical lines are drawn down perpendicularly from the cartilage of the eighth rib to the middle of Poupart's ligament on either side. The central regions are the Epigastric, the Umbilical, and the Hypogastric, and on either side of these the Right and Left Hypochondriac, Lumbar, and Iliac. (See Fig. 82.) Some clinical observers have devised other lines for these divisions, but the difference in the regions is only slight. (See the dotted lines in Bright's Diagram, Fig. 41, p. 341.)

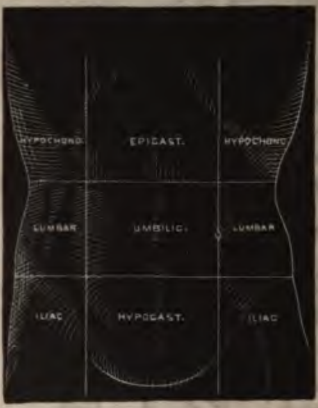

Fig 82.—The *Anatomical regions* of the abdomen.

It is well to have a general notion of what organs occupy these regions. In the *right hypochondrium* lies the right lobe of the liver; in the *epigastric region* the body of the stomach, the left lobe of the liver, and behind the stomach the pancreas; in the *left hypochondrium* the cardiac extremity of the stomach and the spleen; in the *umbilical region* the transverse colon, the mesentery, and part of the small intestine; in the *right lumbar* region the right kidney and the ascending colon; in the *left lumbar* region the left kidney and descending colon; in the *hypogastrium* the small intestine and the bladder when distended; in the *left iliac* region the sigmoid flexure; and in the *right iliac* region the "caput cæcum coli." (See Fig. 83.)

The methods employed in the physical examination are similar to those already indicated in the case of the chest—viz., *inspection*, *palpation*, *percussion*, *mensuration*, and *auscultation*. The last of these is of very limited scope in the abdomen compared with the chest, but all of them should be used so as to check each other at every step of the inquiry.

Before commencing the examination the patient should, as a rule, be laid on his back, with the shoulders a little raised, and the thighs slightly flexed on the pelvis to relax the abdominal muscles. He should be directed also to keep his mouth open, and breathe quietly.

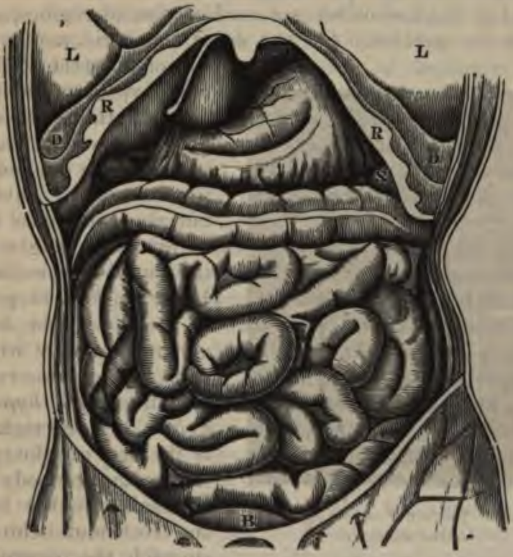

Fig. 83.—*Abdominal viscera in situ.* The omentum has been removed: the costal arch has been preserved. The capital letters are the initials of the structures on which they are placed: L, lungs; D, diaphragm; R, ribs; S, spleen; B, bladder. (From Marshall's Physiological Diagrams.)

INSPECTION.

The abdomen being well exposed, inspection will determine its shape, the condition or the superficial parts, the respiratory movements, and any other movements or pulsations which may exist.

In healthy women and children the abdomen protrudes more than in adult males, in whom, in the recumbent posture, it is often somewhat flattened. If the subject is fat, the surface will be free from marked inequality; but if the parietes contain little fat, and the recti muscles are well developed, they may stand out somewhat on either side of the middle line. The abdomen may become much distended from accumulation of gas in the intestines (see Tympanites, p. 496), or from fluid effusion into the peritoneum (see Ascites, p. 497), or from ovarian tumors, &c. (see p. 499), or combinations of these; or the bulging may be local from tumor of some of the solid organs, or from undue distension of some of the hollow viscera, such as the stomach in stricture of the pylorus. On the other hand it may become much retracted in certain cerebral affections (tubercular meningitis), in chronic lead poisoning, and in cases of obstruction high up in the alimentary canal leading to inanition. The umbilicus occupies a point about midway, as a rule, between the pubes and the xiphoid, but is subject to a certain degree of variation, and in very young children is nearer the pubes. In the strictly normal condition it is depressed, but it may bulge as in umbilical protrusion, and in cases of ascites. During the later months of pregnancy, also, it becomes prominent. The skin is normally somewhat darker round the umbilicus than on the other parts of the abdomen, forming what is called the "areola," and this pigmentation becomes more marked during the course of pregnancy; and in Addison's disease it is a marked feature—the whole surface, however, being unduly pigmented. In women "a brown line" is sometimes seen extending from the umbilicus to the pubes, and is by some reckoned a sign of pregnancy; but this is to be accepted with reservation. It is sometimes also found in males. In women who have born children the abdominal walls are often very flaccid, and in some cases, after many pregnancies, become so thin as to give the impression that there is little else than a layer of skin covering the intestines. White lines, "water lines" (lineæ albicantes), occur on the skin after the distension of pregnancy, and after the absorption of large dropsical effusions. Occasionally the superficial veins are much enlarged and tortuous, this condition being generally associated with some obstruction to the portal circulation, as in cirrhosis, or with some pressure on the inferior vena cava by tumors. The abdominal parietes may be dropsical, and pit on pressure. This œdema is always greatest in the dependent parts, often accompanied by fluid effusion into the cavity of the peritoneum, and usually associated with dropsical effusion into the cellular tissue of other parts of the body. The abdomen is frequently the seat of skin eruptions; some of the febrile rashes indeed, as enteric, have a tendency to appear there first. All such rashes, of course, should be noted and described if present.

The degree to which the abdominal walls participate in the respiratory act is to be carefully observed. In quiet respiration in males the abdominal movement is more marked than the thoracic; while in females the thoracic movement predominates. The type in the male is thus said to be "abdominal," and in the female "thoracic." This abdominal movement may be much restricted in various conditions. Anything which causes distension of the abdomen, and hinders the descent of the diaphragm, will necessarily do so, and all forms of abdominal intumescence may in this way be causes of it. In women the respiration is made more thoracic by the presence of such conditions, and pregnancy has necessarily the same result. But apart from such cases, it may be greatly restricted from voluntary effort, owing to the pain which it excites, as in peritonitis, diaphragmatic pleurisy, or pericarditis. But this abdominal respiratory movement may be exaggerated when from any cause the thoracic movements are restricted, and the chief work of the respiratory process is thrown upon the diaphragm. This is the case in large pleural effusions, in extensive consolidations of the lung, and in emphysematous and asthmatic conditions.

A degree of pulsation is occasionally visible in the epigastric region, and may be due to the heave communicated from the aorta. It is most frequently seen in females, especially those who are thin and of nervous temperament: it must not be confounded with the epigastric pulsation communicated from the heart (see page 455). But visible pulsation may exist in the abdomen from aneurism of the aorta or any of its branches; and cancerous or other tumors may simulate pulsations from their lying over the vessel and having its impulse communicated to them. All the methods of inquiry must be brought to bear in the investigation of such cases. In subjects in whom the stomach or intestines are much inflated owing to any obstruction, peristaltic action may occasionally be seen through the abdominal walls; this may also be visible in the extremely thinned condition of the integuments already referred to.

PALPATION

is a method of investigation widely applicable in abdominal diagnosis, and should be followed out with much detail. The hands of the examiner should not be cold, as this is apt to cause the patient to shrink : and the palpation should not be conducted, at least in the first instance, in a jerky or spasmodic manner with the tips of one or two fingers, but with the whole palmar surface of them applied gently but firmly. As the results of this method of examination will be given in detail under the various organs, only a few general facts need be noted here. It will determine the state of the temperature of the surface, the presence of flaccidity or rigidity of the walls, the condition of the abdominal rings, the degree of resistance at different points, and whether parts are freely movable; when associated with percussion it enables us to detect fluid in the peritoneum (see Ascites, p. 497). It will reveal the fact of smoothness or irregularity of the abdominal organs ; it will determine the presence and character of pulsations; and peritoneal friction may sometimes even be detected by it. This is got either by causing the patient to breathe forcibly while the flat of the hand is laid over the suspected organ, or it may be elicited by sliding the abdominal wall over the part (see p. 342). In the case of abdominal tumors palpation will determine their characters, and whether they are affected by respiration or not; tumors closely associated with the movable organs lying beneath the diaphragm being depressed and elevated in respiration. Palpation may also determine the fact of pregnancy by noting the movements of the fœtus in the uterus, as well as enabling us in certain cases where the abdominal walls are thin, or in an extra-uterine fœtation, to recognize the head, feet, or other parts of the child. It also elicits important information as to the presence or absence of pain or tenderness. In certain conditions pain is so acute as to forbid palpation. This is especially (but not invariably) the case in acute peritonitis, where the pain is often so exquisite as to lead the patient to flex the thighs upon the pelvis in order to relax the abdominal muscles and protect the belly from the pressure of the bed-clothes. On the other hand, acute pain when of the neuralgic or colicky type is sometimes relieved by pressure. If tenderness on pressure exists over a limited area in the epigastric region, it may point to the presence of gastric ulcer; and in inflamed or suppurating conditions of any of the organs or structures in the abdomen, pain on pressure is as a rule a marked feature.

PERCUSSION

is to be performed in the manner described in the section on the physical diagnosis of the lungs. The note yielded over the air-filled organs in the abdomen is tympanitic, having a distinct musical tone, and the quality of this note varies according to the size and degree of distension of the organs. The note obtained over the stomach is fuller and lower in pitch than that over the colon; the note over the colon bears a similar relation to that over the small intestine. It is by means of this change in quality that the different parts of the intestine can be distinguished from each other, and the student should study them in this light, contrasting the percussion tone with that obtained over a solid organ such as the liver, which is "dull," and that obtained over the lung which is termed "clear." Auscultatory percussion is sometimes of value in the delimitation of air-filled organs (see below).

MENSURATION

is used to determine the circumference of the abdomen, the tape being applied at the most prominent part, usually a little above or below the umbilicus, or at some other definite point. This gives a datum for future measurements, and increase or decrease can readily be determined, care being taken that the tape is applied at the same level and with the same tension. The distance of the umbilicus from the ensiform cartilage or the pubes has occasionally to be noted. The areas of percussion-dulness of the various organs, whether normal or abnormal, should be accurately measured and stated, and points to be indicated should be measured from definite anatomical landmarks such as the umbilicus, ensiform cartilage, iliac spines, &c., and not vaguely referred to the regions in which they lie.

AUSCULTATION

is of chief value in abdominal diagnosis in the detection of vascular sounds, whether connected with abnormal conditions such as aneurism, uterine tumors, &c. (see p. 500), or with normal conditions during pregnancy (for fœtal heart, uterine souffle, &c., see p. 414). It is also applicable in dilatation of the stomach to determine the fact of succussion (see p. 495), and occasionally in the determination of peritoneal friction, chiefly over the liver. It may be used in the diagnosis of stone in the bladder, the stethoscope being placed above the pubes, while the stone is struck with the sound. "Auscultatory percussion" is sometimes used to delimit air-filled organs, such as the stomach. For this purpose the observer places his stethoscope over the epigastrium while an assistant percusses from the periphery, till a point is reached at which the note is communicated with sudden and great directness to the listener, and this may be marked as the confine of the organ. The same method is pursued all round the stomach, the patient's position being altered to allow the fluid to change its place, and the area occupied by the viscus can thus be mapped out with tolerable exactitude, if the note of the colon does not approximate to that of the stomach. It is absolutely necessary to shift the patient from one side to the other in this examination, otherwise only the level of the fluid contained in the stomach will be ascertained.

The most convenient method, probably, of treating of abdominal diagnosis is to take up the principal organs in detail, considering them first in their normal relations, and then passing on to abnormal conditions. In such an arrangement the liver naturally claims attention first.

LIVER.

In the section devoted to the physical examination of the lungs it was noticed that the pulmonary percussion was bounded inferiorly all round the right side by the upper margin of hepatic dulness. In order to define this margin, the percussion should be carried from the clear pulmonary area down on to the dull liver, using a *light* stroke, and at a point one inch and a half or two inches below the right nipple, a change will be perceived in the note, as well as in the sense of resistance, and this indicates the spot at which the lung ceases to overlap the liver. This is the boundary of "*absolute*" dulness; the deep or "*relative*" dulness which indicates the highest point to which the liver ascends under the diaphragm is at a considerably higher level than this, and is got with strong percussion performed during expiration. The description here given will apply to the superficial, or absolute dulness. The upper border is followed into the cardiac dulness in almost a straight line—there being, however, a tendency for it to descend a little towards the inner extremity, where it joins the precordial dulness on a level with the base of the ensiform cartilage. It is then extended in the lateral region and the back, and will be found to descend somewhat as it nears the spine, usually at the tenth or eleventh dorsal vertebra. Having marked this upper limit of percussion with ink or otherwise, the lower margin will next engage attention, the percussing stroke being carried up from the tympanitic intestine. This lower margin in the right mammary line will be found to coincide pretty exactly with the margin of the ribs; in the axillary line it corresponds to about the tenth intercostal space, and it crosses the epigastrium at a level of about two inches below the xiphoid, and joins the left margin of the cardiac dulness. The left lobe of the organ can thus be felt in the epigastrium, giving a sense of increased resistance; but, as a rule, its lower edge cannot be strictly defined by palpation.

The average extent of hepatic dulness, according to this mode of percussion, in a healthy adult of medium size is from 2½ to 3 inches in the mesial line of sternum, 4 inches in the line of the nipple, and 4½ or 5 inches in the axillary line.

It must be remembered that these limits, which presuppose the recumbent posture, may alter to some extent on the patient's assuming the erect attitude, and in certain conditions of respiration. Thus, on deep inspiration, the whole organ is somewhat depressed, and its upper limit overlapped to a greater extent by the lung. The student should be careful to appreciate these changes. In children in whom the liver is naturally large, the upper margin of dulness may approximate to the nipple, and the lower descend somewhat beneath the costal arch; and there are various deformities of the chest, such as those induced by rickets, emphysema, and tight lacing, which tend to throw the organ to a greater or less extent from under the cover of the ribs, and so simulate enlargement. Congenital malformations of the organ may also be present.

The demarcation of the lower edge of the liver should never be considered as settled from a single examination, as there are various conditions which temporarily affect it. Thus, if the stomach and intestines are distended with gas, they may conceal the lower edge, and the area of dulness may appear diminished. Again, if the examination is made after a full meal, the dull percussion from the stomach may mask the lower edge of hepatic dulness; or there may be accumulation of feces in the colon having a similar effect. In cases of thickened omentum also, where the recti muscles are very rigid, or where there is dropsy of the abdominal wall or of the peritoneum, the exact determination of the lower edge may be very difficult or even impossible.

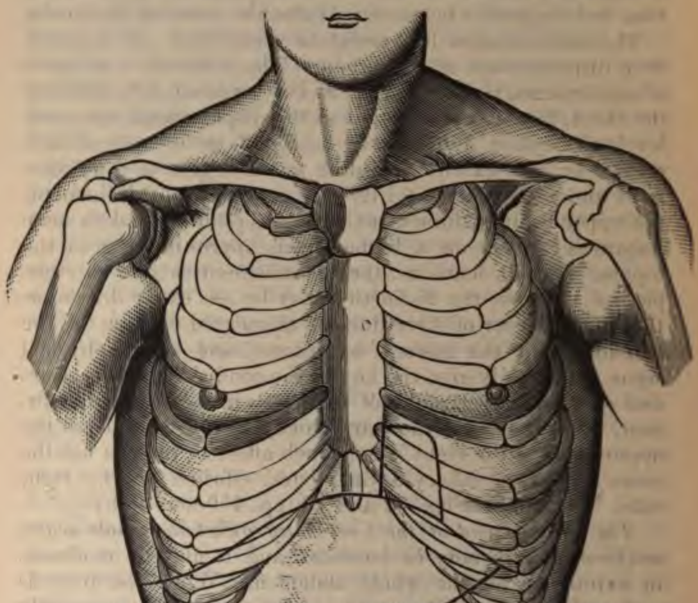

Fig. 84.—*Displacement of cardiac and hepatic dulness* in emphysema of the lungs. (Weil.)

Large abdominal tumors, by their pressure upwards, will tend to push the liver further under the ribs, and so raise both its upper and lower limits of percussion; while pleural effusions of air or fluid, marked emphysema of the lungs, tumors in the chest, and enlargements of the heart will depress the organ into the abdomen. The diagnosis in such cases must be guided by the history and other physical signs.

The size of the liver is liable to vary to some extent even in health under the influence of diet; but this is only a temporary fact. In all cases where the liver is permanently increased in bulk, the enlargement is, as a rule, chiefly in the downward direction—the liver projecting beyond the ribs, and palpation becoming a valuable means of diagnosis.

The student must be careful to distinguish enlargement from displacement of the organ. The distinction in cases of emphysema, tight-lacing, or rickety or other deformities of the chest, lies in the fact that in the displacement the upper level of hepatic dulness will be found to be lowered to a greater or less extent according to the degree of projection from under the ribs (see Fig. 84); whereas, in enlargement, the upper limit of dulness maintains its position, and in some instances is even on a higher level, approximating to the nipple. When, however, the displacement is due to right pleural effusion, the distinction may be less easily drawn, as the upper border of liver dulness is merged in that of the effusion; but the history, symptoms, and other physical signs will usually give the key to the condition. In pericardial effusion, hypertrophy of the heart, and left pleural effusion, the left lobe is the part chiefly depressed, and, as the upper limit of the right is not much affected, there is not the same liability to fallacy as in pleural effusion on the right side. (Compare Figs. 72 and 73, pp. 459 and 460.)

The enlargement of the liver may affect the whole organ uniformly, or it may be localized, and it may be moderate in extent, or fill the whole abdomen. When the liver is uniformly enlarged, the outline of the organ is not materially altered. The percussion of its limits should be followed out, and palpation should always be brought to test the lower margin; in not a few instances it will be found that the lower edge can be felt to project to a quite decided extent beyond the limit of percussion-dulness. This is especially the case in fluid effusion, and, to detect the lower edge in such instances, it is frequently necessary to pursue palpation in a different method from that indicated in the commencement of this section. It has to be done with the tips of the fingers, suddenly and strongly, in order to penetrate to the liver. It is often possible also in uniform enlargement, to map out the notch of the liver, which will be found somewhat near the mesial line of the abdomen, and it may be appreciable not only by palpation, but as a small bay of clear percussion penetrating the line of dulness. In some instances, also, where the fissure of the gall-bladder is well marked, it can be detected, though with nothing like the frequency of the notch. In ascites the percussion of the lower edge of the liver cannot be depended on, and palpation has to be chiefly used in the delimitation of it. In uniform enlargement the upper limit of dull percussion approaches the nipple level; and when the increase in size is considerable, it is often possible, by applying the one hand in front and the other in the lumbar region behind, to grasp the organ and communicate a sense of impact from the one hand to the other.

Density, Smoothness, and Irregularity.—The hepatic region in cases of enlargement can often be seen distinctly bulged, and, on applying the hand over the part that projects, the sense of resistance and the fact of smoothness or irregularity of the surface will be recognized. If the organ is smooth, uniformly enlarged, dense and resistant, it is most probably either amyloid, fatty, congested, or the seat of simple hypertrophy, as in leukæmia; the amyloid condition is, as a rule, the most dense, and often associated with enlargement of the spleen and albuminuria. If, on the contrary, the surface of the organ is irregular, nodules of varying size existing on its surface, and in some instances projecting beyond its lower edge, and especially if some of these nodules can be felt to be depressed or umbilicated in the centre, and palpation elicits a degree of pain or tenderness, then there is strong ground for the suspicion of cancerous disease of the liver. If, however, the irregularities on the surface are small, and associated with symptoms of obstruction to the portal system, such as ascites, hemorrhage from the stomach or bowels, &c., then it may be a case of cirrhosis, or "gin drinker's liver," although this disease is not, as a rule, attended by enlargement, but rather atrophy. Uniform enlargement is apt to occur in all cases in which there is obstruction to the systemic circulation; and so in diseases of the heart, especially of the right side, it is a very frequent fact, the constant congestion of the portal system giving rise to it. This may also occur from persistent dietetic excesses.

But the enlargement may not be uniform, but only involve one or other lobe. This is especially the case in hydatid disease and tropical abscess. In both these cases a distinct tumor often exists, and if it lies near the surface, fluctuation, or at least a sense of elasticity can be felt, and in the case of the hydatid disease on percussion there is sometimes detected a sense of tremor called "hydatid fremitus." This is elicited by laying three fingers over the seat of greatest distension and percussing strongly over the middle finger. The affections are differentiated by the grave constitutional symptoms and local tenderness in the case of abscess, and the almost total immunity from them in the case of hydatid disease.

With or without enlargement of the liver there may be present a projection of dull percussion and increased resistance from its under surface. If this arises from the region of the gall-bladder, if it conveys the sense of fluctuation or elasticity, and is pyriform in shape and tender to pressure, it is most probably the gall-bladder enlarged from obstruction to its duct. In some instances gall-stones are also present in the sac, and crepitation may be elicited sometimes from the rubbing of these on each other. A history of hepatic colic, and perhaps even the passage of gall-stones, may serve to throw light on the case. (See Chapter xii., on Jaundice, p. 332.)

Diminution in the size of the liver can never be so certainly stated as enlargement, as the area of hepatic dulness is apt to be much encroached on by emphysematous lungs or distended intestine. But actual diminution in size may take place. This is especially the case in cirrhosis and other forms of chronic atrophy and in acute yellow atrophy of the liver. This latter condition is very rare, acute in its course, and associated with symptoms of great vital depression, and the atrophy may be extreme. It occurs chiefly in females, and pregnancy is a predisposing cause. In cirrhosis the atrophy is not extreme, it is not acute in its course, and there is often a history of spirit drinking.

The presence or absence of pain or tenderness in diseases of the liver must be investigated. Murchison makes it the ground for his division of enlargements of the liver into "painful" and "painless." Among the "painless" we have the so-called amyloid liver, the fatty liver, hydatid tumor of the liver, and simple hypertrophy. Among the "painful" we have congestion, catarrh of the bile-ducts, interstitial hepatitis, pyæmic abscess, tropical abscess, and cancer. He also remarks that painless enlargements are characterized by an absence of jaundice and ascites, and by a chronic course, but in painful enlargements jaundice and ascites are common symptoms, and the progress is more rapid.

SPLEEN.

In the normal subject the spleen can be detected by percussion only, as it lies quite under cover of the ribs in the left hypochondrium, its convex surface corresponding with the 9th, 10th, and 11th ribs. Prior to attempting its delimitation, it is well to determine the percussion of a line passing from the left axilla downwards and inwards to the umbilicus. This line will necessarily be oblique, and if required it may be curved to carry it outside the areas of cardiac and hepatic dulness, both of which should be defined before attempting the percussion of the spleen. This line will be found to be more or less resonant throughout; in its upper part pulmonary resonance is obtained; and then passing across stomach, colon, and small intestines, the differences in the tympanitic note of these organs may be more or less distinctly realized. The presence of such a resonant line removes various sources of fallacy from pleuritic or pericardial effusions, pulmonary condensations, enlargement of the left lobe of the liver, fluid or solid accumulation in the stomach, &c. Having determined this line, light percussion should be made backwards and downwards from it towards the splenic region, till a change in the note is discovered; the percussion should then be carried down from the axilla on to the upper margin of spleen, or rather to the point where the lung ceases to overlap the organ; and percussing upwards from the tympanic abdomen into the hypochondrium, the lower border will be found normally inside the costal arch. The posterior margin cannot be indicated with any degree of certainty. In the average subject this area of dulness will measure from two to three inches in the oblique diameter, but this dulness varies greatly even in normal conditions, and slight decrease or increase in its size can never be confidently stated.

Enlargement of the spleen is, as a rule, almost entirely downwards and forwards, unless it is very firmly bound by adhesions to the diaphragm. Considerable enlargement may take place, and may be detected by percussion alone, unaided by palpation, as the organ lies so much inside the margin of the ribs as to admit of considerable increase in bulk before it projects from under the costal margin. Even in such cases, however, it is often possible by pressing the fingers well up under the costal arch to make out a sense of tumor or increased resistance. But percussion plays the principal part in the diagnosis. When, however, the organ passes below the ribs, palpation becomes of prime importance, and with one hand in front and the other behind, the organ can be grasped and tilted backwards and forwards. The enlargement may be so great as to fill the whole left side of the abdomen down even to the pubes, and the fact of its being spleen may be somewhat obscure, but if the enlargement is moderate there is usually little difficulty in determining the organ involved. A tumor arising from the left hypochondrium, which is superficial and mobile, with rather blunt edges, and with a notch in its anterior border, can hardly be anything else than spleen. The most likely sources of fallacy are enlarged or floating kidney, and fecal accumulations in the splenic flexure of the colon.

There are certain conditions in which palpation can detect the spleen when not enlarged but displaced. In certain deformities of the chest, as in rickets, the spleen may be thrown to a greater or less extent from under cover of the ribs, in the same way as the liver. In like manner large pleural effusions in the left side of the chest will depress the spleen and bring it within the reach of palpation.

In emphysematous states of the lungs, or great distension of the intestines with gas, the splenic dulness may be much encroached on and thus appear diminished.

Causes of enlargement.—Enlarged spleen may arise from passive congestion from obstruction to the portal system in cirrhosis of the liver; active congestion, as in certain fevers (especially enteric and relapsing), and above all in ague; and the constantly recurring congestion in this last affection may lead ultimately to chronic enlargement ("ague cake"). But the increase in volume may be due to splenic leukæmia, the diagnosis being aided by the discovery of increase in the white blood corpuscles; or it may be from amyloid disease, in which case the liver will most probably also be enlarged, and the urine will usually be found to contain albumen from a similar condition in the kidney. Colloid cancer, inflammation, and in very rare cases, abscess of the spleen may also lead to enlargement. Embolism of the spleen may lead to considerable enlargement, and in such cases friction may sometimes be detected over the organ in the early stage;

in young children of rachitic habit the organ is sometimes considerably enlarged as well as displaced.

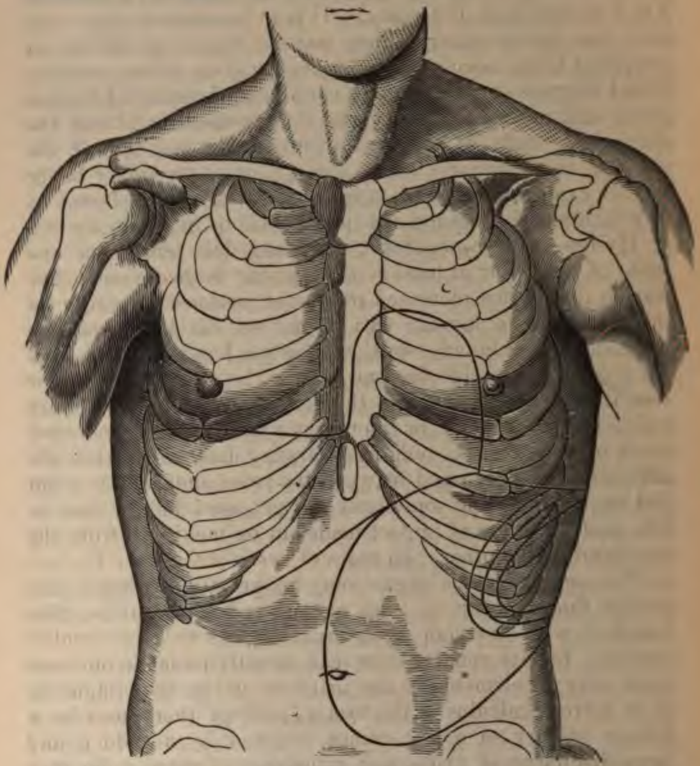

Fig. 85.—Various degrees of enlargement of the spleen. The lines indicative of splenic enlargement are copied exactly from Weil, but the percussion limits of the heart and liver have been somewhat modified.

THE KIDNEYS

lie so deep in the lumbar region, and in such close proximity to solid structures, that they cannot often be marked out by percussion in the natural condition with anything like accuracy. The patient should be laid flat on his face, with all the lumbar muscles well relaxed; the tympanitic note of the colon is realized, and the percussion carried backward to the anterior edge of the kidney. The upper edge is approached in a like manner, and is usually situated on a level with the first or second lumbar vertebra, and the anterior edge from 3 to 4 inches from the spine. It is to be remembered, however, that one or other kidney may be absent altogether, or atrophied from calculus, or may occupy some other position. Slight degrees of enlargement cannot be determined by palpation and percussion, especially if the patient is fat and the abdominal walls resistant; and in most cases, indeed, the physical examination of the kidney is quite secondary to the careful examination of the urine. There are cases, however, in which positive results can be got. Thus in cystic disease, or Hydro- or Pyo-nephrosis, increased dull percussion and sense of tumor, or at least resistance, can be made out. The way to detect this increased resistance, or sense of weight in the flanks, is to lay the patient flat on his back with the muscles quite relaxed; we then apply a hand to either lumbar region, and weigh the one against the other, when, if the case is at all well marked, there will be little difficulty in fixing on the heavier or more resistant. Sometimes, also, there may be distinct bulging. Having determined this, the affected flank is grasped between the two hands, one in front and one behind, and sometimes the enlarged kidney can be felt, and the sense of impact made out on moving it from the one hand to the other. In cases of cystic disease, or Hydro- or Pyo-nephrosis, the organ may be greatly distended, distinctly fluctuant, or at least elastic, and it might be confounded with ovarian cyst, hydatid disease, or lumbar abscess; but its renal nature can usually be made out, and there may be elements in the urine to guide the diagnosis. If it is from calculus in the ureter, perhaps there may be a former history of a like tumor relieved by a sudden and large discharge of urine, and symptoms of renal colic may have preceded the formation of the tumor. In Pyo-nephrosis, also, it sometimes happens that there is a history of a similar large discharge of pus, with subsidence of the tumor; or at least variations in the quantity of pus excreted in the urine may occur, and this may guide the diagnosis. The kidney may also be enlarged from cancerous, sarcomatous, or hydatid disease. Perinephritic abscess may simulate renal tumor, but can be usually distinguished on account of its affecting the psoas muscle as indicated by flexion of the thigh on the pelvis.

The kidney may become displaced. Floating kidney is not always easy of diagnosis, but if there is an abdominal tumor in the abdominal region, smooth, ovoid, presenting the characters of the kidney, freely movable, capable of being replaced into one or other renal region, tender to pressure, but unattended by serious constitutional disturbance, then the suspicion of floating kidney should be entertained; this is all the more likely if we can determine the absence of either kidney in the lumbar region.

PANCREAS.

In the healthy condition, physical diagnosis fails to detect the pancreas, or at least to give data of any importance; but when it is the seat of disease (chiefly cancerous), and the patient is emaciated, it may come to present a palpable tumor, lying across the upper part of the abdomen, chiefly in the epigastrium, very deep, and often receiving an impulse from the aorta or superior mesenteric artery. It is likely to be confounded with aneurism, but the pulsation may be determined to be not expansile, being simply a heave communicated to the tumor from the vessel. It may also be confused with other deep tumors, and in such cases the diagnosis can only be inferential. Tumors in the stomach may also be mistaken for it, but these are usually more superficial, more mobile, and often obey the respiratory movements of the diaphragm. The appearance of fatty matter in the stools is presumptive evidence of disease of the pancreas. Jaundice may be present in some cases of disease of the head of the pancreas from pressure on the bile-duct.

THE STOMACH

will usually be found to occupy the epigastric and part of the left hypochondriac regions, but its position is subject to great variation according to its state of distension and the condition of surrounding organs, its mobility allowing of much displacement. If the left lobe of the liver is enlarged, the stomach may be pushed down into the umbilical region; and owing to ascites, abdominal tumors, &c., it may be pushed up so as to lie much under the cover of the ribs. In retraction of the left lung in phthisis, it may be dragged up into the left lateral region, and in extreme cases may be found high up in the axilla.

The stomach may become enormously distended. This most frequently happens in stricture of the pylorus (simple or malignant). The distended organ may fill almost the whole abdomen, and even encroach to some extent on the chest, especially the left side, but the distension is, as a rule, distinctly related to the epigastric region. The peristaltic action may sometimes be observed through the abdominal wall, and the examination of the vomited matters may aid in determining the existence of dilatation. (See p. 311.) The percussion note is highly tympanitic, and the organ can generally be pretty accurately mapped out, if the method of auscultatory percussion, already described (see p. 484), is employed. As there is usually fluid as well as air in the organ, change in position may alter the percussion limits. Thus, if the paient is laid on his left side, the fluid will gravitate into the "cul de sac." This fluid level should be carefully determined and marked in ink, and the patient laid on his back or left side, when the dull area will become typanitic, and the dulness will shift to the dependent portion. If the patient is placed on his hands and knees, the dulness will be transferred to the front, and the lateral region will be clear. If the hands are placed on either side of the distended organ, and the patient shaken, the fluid will be felt dashing from the one side to the other, and the splashing sound is often audible to the bystander; while, if auscultation is employed, Hippocratic succussion and its metallic phenomena are well heard. If the quantity of fluid in the stomach is considerable, and the fingers are depressed suddenly and sharply into the epigastric region, a sense of their passage into fluid is sometimes apparent.

As distended stomach often depends on obstruction at the pylorus, palpation should be employed to see if any undue hardness, resistance, or tumor exists in that region. The pyloric orifice in such cases does not always maintain its normal position; it may be displaced to a great extent, but will generally be found somewhat to the right of the mesial line, and in the upper part of the abdomen. If cancerous disease of the pylorus exists, pain on palpation is usually complained of. Distension of the stomach may, however, be due to atony of the muscular coat.

But the tympanitic note over the stomach may be replaced by dulness. This may be quite absolute to superficial percussion, but on a stronger stroke being employed a trace of the tympanitic quality may still be found. Associated with this there may be distinct resistance and hardness on palpation, the pressure at the same time causing pain. These conditions are chiefly due to tumor of the body of the stomach usually cancerous in its nature. Pain on pressure over the stomach, however, limited in its area, and unassociated with dull percussion or increased resistance, may be due to simple gastric ulcer. The diagnosis must rest on the symptoms.

THE INTESTINES

occupy the greater part of the abdomen. The small intestines lie in the lower and front part of the cavity. The transverse colon crosses the upper part of the umbilical region, and the descending and ascending colon occupy the posterior parts of the lumbar regions. The "caput cæcum coli" lies in the right, and the sigmoid flexure in the left, iliac region, but the latter is usually overlapped to some extent by the small intestine. Over the intestine the note is tympanitic, but it varies in its quality according to the size and state of distension of the part. Normally the colon has the deeper and fuller note. Areas of local dulness may present themselves at any part, depending on accumulation of feces or other substances in the intestines, tumors of the intestine, or of the glands, or of some of the other viscera in the abdomen ; or the whole area of intestinal percussion may become more or less dull owing to morbid deposits in the peritoneum and omentum (tubercular or cancerous peritonitis), large tumors of the solid organs, effusion of fluid into the peritoneum, &c. On the other hand the intestines may become much inflated with gas and render the abdomen large, prominent, and unduly tympanitic, constituting what is known as "*Tympanites.*" This condition arises in many instances from obstruction in some part of the canal (intussusceptio, hernia, constriction from bands of lympth, twists in the gut, inflammation in its walls, accumulation of feces or foreign bodies, cicatrization of ulcers, strictures simple or cancerous, &c.) In many cases, however, it is quite independent of obstruction, being often found in acute peritonitis, in hysterical patients, in cases of dyspepsia where the digestive powers are feeble, in enteric fever, and in spinal lesions where there is atony of the muscular fibre of the tube. In certain very rare cases the tympanites may arise from accumulation of gas in the peritoneal cavity.

In tympanites the abdomen is well projected in front, spherical, everywhere unduly resonant (unless the distension is extreme, when it may become somewhat dull), and the coils of intestine may be defined through the abdominal walls, and peristaltic action observed in them. If the distension depends on obstruction the degree and distribution of the tympanites may to a certain extent guide the observer to the seat of lesion. If it is low down (in the rectum or sigmoid flexure) the distension will be found to occupy not only the anterior parts of the abdomen but also the flanks, the inflated colon bulging the lumbar regions. But the obstruction may exist at the ileo-cæcal valve, and in such cases the swelling will occupy chiefly the umbilical and lower parts of abdomen, there being no great distension in the lateral region, and notably no bulging in the flanks.

ASCITES

is often present in diseased conditions of the abdominal organs, more especially of the liver. The quantity of fluid in the peritoneum varies greatly in different cases, but when it is so abundant as to fill nearly the whole abdominal sac, it gives the belly a somewhat spherical shape, causes the umbilicus to protrude, and yields a uniformly dull note on percussion, except perhaps near the xiphoid cartilage, where the resonance of the stomach and intestines may be detected. When the patient is laid on his back the gravitation of the fluid causes the flanks to bulge, while the anterior part of the abdomen becomes less prominent. The abdominal walls are tense and resistent, and the veins on the surface are often enlarged and tortuous, owing to the pressure on the large venous trunks in the abdomen. If the fluid effusion is moderate in quantity, the normal tympanitic note is retained in the higher parts, owing to the floating up of the intestines. In such cases the fluid, if not cooped up by adhesions, will be found to obey the law of fluid level. Thus if the patient is laid on his right side, the left side of the abdomen will yield a resonant note, while the right is dull. The limit of the dulness should be marked, and the patient laid on his left side, when the conditions will be reversed. If laid on his back the flanks are dull and the anterior parts resonant (compare Fig. 40, p. 340); and if he sits up, the fluid gravitates into the hypogastrium. In cases where the quantity of fluid is small and doubt exists as to its presence, the patient should be placed on his elbows and knees, and if the fluid is free the most dependent part will then give a dull note in the umbilical region.

Another very valuable sign, when the fluid is in sufficient quantity, is fluctuation. To apply this test the patient should be laid on his back. The observer should then place a hand on one side of the abdomen, and with the fingers of the other tap firmly, but not too strongly, on the opposite side, and in many instances the fluid wave is felt to be clearly transmitted. But the wave may not be got in this particular region, and it is well in all cases to try it in others, as with the hand in the umbilical region while the tap is delivered on either side. There is a danger of fallacy in this fluctuation test against which the student must be on his guard, for in cases where the abdominal walls are very tense (as in tympanites), or loaded with fat, a tremor is communicated very like fluctuation. Careful attention to other points will usually prevent this mistake. Large dropsical effusion into the cellular tissue of the abdominal wall may render fluctuation very obscure, or abolish it altogether.

Fluid may exist in the peritoneal cavity, and yet not obey the law of gravitation—the inference being that it is confined by adhesions. The most frequent causes of this are tubercular and cancerous diseases of the peritoneum, which, by matting the intestines together, coop up the fluid. The fluctuation test, however, may remain distinct, though never present to the same degree as in simple ascites, for there are changes induced in solid parts which obscure the wave. In many cases, also, the resistance to palpation, owing to thickening of the peritoneum and omentum, can be verified; and, as the thickened mass lies in front of the small intestine, we are able to judge to some extent of its thickness by percussion; the percussion note, when the thickening is not great, is superficially dull, while to a stronger stroke it is tympanitic. In tubercular cases, which occur chiefly in children, the fluid may be absorbed, and the thickened and retracted omentum may be realized by palpation as it passes across the abdomen below the stomach.

The conditions most likely to be confused with ascites are ovarian or parovarian cysts, hydatid disease of the liver or the peritoneum, distended bladder, and phantom tumor.

OVARIAN TUMORS AND CYSTS.

This is a condition very apt to be confounded with ascites, especially if the cyst is unilocular, or has one or two compartments developed out of all proportion to the others. In most cases the history is an important guide. The growth may have been first discovered as a small painless tumor in one or other iliac region, having gradually extended across the abdomen. The abdomen is well projected in front, and not bulged in the flanks as in ascites, and the umbilicus is rarely protruded. The percussion dulness is in the anterior part of the abdomen as the cyst expands up in front of the intestines, and pushes them backwards and upwards. (Compare Fig. 41, p. 341.)

Tympanitic percussion is thus got in the flanks, and alterations in the position of the patient do not change materially the relations of the dull and tympanitic areas. This is evidence that the fluid is not free. Fluctuation is common in ovarian cyst, but it may be vague, palpation giving more the sense of elasticity, and in some cases solid matter can be detected at various parts of the tumor. On vaginal examination, the uterus may be found normal in size, but high up in the pelvis, and perhaps displaced forward. In some cases the finger in the rectum can determine the relation of the tumor to the ovary, or its immediate vicinity; and examination with the uterine sound fails to show any direct connection with the womb. (See p. 420, &c.)

In many instances, however, ovarian cysts are accompanied by fluid effusion into the peritoneum, and the diagnosis may only be made clear by tapping and examination of the fluid withdrawn. (See p. 346.)

OTHER ABDOMINAL TUMORS.

An ovarian cyst may be simulated by solid tumors of the ovaries or uterus, and even the gravid uterus has been mistaken for it. The careful application of auscultation will usually determine the diagnosis of pregnancy, and solid uterine tumors may be distinguished by their density, by their relations to the uterus, especially when examined by the uterine sound, by the elongation of its cavity, and an increase in its size and weight. (For details see p. 420, &c.)

A distended bladder might also be a source of confusion, but its growing out of the pelvis, fairly in the middle line, and being pyriform in shape, and often tender on pressure, would probably raise such doubt as to lead to the introduction of a long flexible catheter, when the tumor will disappear.

Hydatid disease of the liver may enlarge so greatly as to fill the whole abdomen, but the history of growth from the right hypochondrium will often be quite clear, and the hydatid fremitus may be present. Hydatid disease of the peritoneum or omentum may present greater difficulty, and the diagnosis from ascites or ovarian cyst may only be arrived at by tapping and examination of the fluid, the presence of hydatids or hooklets determining the point at once. Even in the absence of these the characters of the fluid may give quite sufficient ground for the diagnosis. (See p. 346.)

Phantom tumor may present difficulties in diagnosis. It occurs almost exclusively in women, especially in those with an hysterical tendency, and it may simulate almost any form of abdominal enlargement; but the fact of its liability to vary in size and shape, the tension of the abdominal walls, and its disappearance under the influence of chloroform, will clear up the diagnosis.

ANEURISM OF THE ABDOMINAL AORTA is most common in the epigastric and umbilical regions, and may be recognized as a tumor placed in the length of the artery, lying in close apposition to the spine, but to the left side, and giving to the hand the sensation of expansile pulsation, in many cases associated with thrill. On auscultation a murmur may be heard coinciding with the expansion of the artery; in rare cases it may be double. Aneurism of any of the branches of the abdominal aorta may exist, especially the cœliac axis or superior mesenteric. Pulsation of the abdominal aorta attended by murmur may be present without aneurismal conditions (see p. 263), but in such cases there is no impression of a distinct tumor which pulsates, and of a murmur limited to the tumor and not merely corresponding with the track of the aorta. Aneurisms may be simulated by tumors lying over the aorta, and having an impulse communicated to them. The diagnosis rests chiefly on the non-expansile character of the pulsation, but in many cases it is quite uncertain. Pain is often a marked feature in abdominal aneurism. It is usually felt in the back, is constant in character, as a rule, but subject to violent exacerbations, with extension of it down along the sacral and lumbar cords. Obscure pain of th [illegible] even from physical signs, should always [illegible] rism.

LOCALITIES OF TUMORS.

Leaving out of consideration the general enlargements of the abdomen due to ascites and tympanites, it may be well to indicate briefly a few facts with regard to local enlargements or tumors. A tumor being discovered in the abdomen, the whole physical inquiry hinges on the question, What organ or structure is it connected with? In such an inquiry it is of prime importance to consider the regional divisions of the abdomen mentioned in the early part of this section, and the organs contained in them. If the tumor is confined entirely or chiefly to one of these regions, then the various organs must be gone over in detail to see from which it springs. In serious diseases, however, the abdominal organs may be greatly displaced from their ordinary position. It will suffice for our purpose to indicate what tumors are most frequent in the various regions.

In the *epigastric region* the tumors most frequently met with are cancerous disease of the pylorus or body of the stomach, enlargements of the left lobe of the liver, tumors of the pancreas, and aneurisms of the aorta. It is to be remembered that the left lobe of the liver may present itself as a tumor without there being any enlargement of it, conditions in the thoracic viscera having depressed the organ. This fallacy is to be guarded against, and the same remark applies to the liver in the right hypochondrium and to the spleen in the left.

The tumors met with in the *umbilical region* are aneurisms of the aorta and omental tumors, fecal accumulations in the transverse colon, and at times cancer of the intestine and enlarged mesenteric glands. Fecal accumulations may occur even with a history of diarrhœa. Through the abdominal wall they can be moulded to some extent by steady pressure with the fingers, and may be even displaced a little along the bowel.

Tumors originating in the *hypogastric region*, are distended bladder, the gravid uterus, tumors of the womb, and inflammatory growths in the pelvis.

Those originating in the *right hypochondrium*, are chiefly from the right lobe of the liver or gall-bladder.

In the *left hypochondrium*, the spleen is the organ chiefly affected, although fecal accumulations in the splenic flexure may occur.

In the *lumbar regions*, tumors of the kidney, perinephritic abscess, lumbar abscess, and fecal accumulations are most frequent.

In the *iliac regions*, ovarian cyst, pelvic abscess, disease of cæcum or sigmoid flexure, enlarged glands, pelvic cellulitis or hæmatocele are found.

It is rare, however, for tumors to occupy only the region from which they spring. They often involve several; and it is only by a careful consideration of the history and symptoms, along with the physical signs, that a diagnosis can be arrived at. In not a few instances several organs may be affected, and this renders the examination all the more perplexing. In many cases the most critical exploration will fail to resolve the doubts.

CHAPTER XVII.

METHOD OF PERFORMING POST-MORTEM EXAMINATIONS.

In performing post-mortem examinations it is of consequence to get into a habit of going through the various operations in a systematic way. It is only thus we can insure that nothing of primary importance is overlooked. Not that it is necessary to be the slave of any particular system, but that the thing should be done on a certain plan, any deviations that are called for being made, but at the same time recognized as deviations, and the regular course resumed as soon as possible.

Instruments and Method.—The instruments required are comparatively few. The first is a good stout knife, such as that used in Syme's amputation. Then one or two scalpels and dissecting forceps, a pair of gut scissors, and a pair of strong probe-pointed scissors[1] are required. A saw, chisel, and hammer or wooden mallet (better the latter), a probe, a dissecting needle, and a cartilage-knife, complete the ordinary equipment. The cartilage-knife should have a triangular blade, the edge being straight, and forming an angle of about 35° with the back, which should be very strong and thick. This knife is seldom satisfactorily made; it should have a back like a razor, but be ground to the shape described.

The first lesson the student has to learn is to hold the knife properly, and he should remember that what is wanted is not a dissection of each muscle and nerve, but a rapid and comprehensive survey of each organ in the body. The knife must therefore be held so that full, sweeping strokes may be made with it. The handle should be grasped firmly in the closed fist, the edge of the blade corresponding with the palmar aspect of the hand, not held delicately like a pen or a dissecting-knife. Again, in cutting, the belly of the knife should be used, and not merely the point as in dissecting. This is a matter which it is very difficult to get students to appreciate, and it is very important, both on account of the saving of time, which a proper method involves, and also because a good clean cut exposes the structures to be examined very much better than an imperfect, half-tearing one. Let the knife be grasped firmly, and learn to make the incisions with the whole weight of the arm, and, if necessary, of the body, the wrist being kept rigid.

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[1] I have found some difficulty in getting from the instrument-maker these probe-pointed scissors, but as they are of great use they should be specially ordered.

It may here be remarked that in the following description the writer has simply imagined himself to be making a post-mortem examination, and has endeavored to set down the various operations which he is in the habit of performing. If the student in reading the description will imagine that he has the knife in his hand, and will follow each step as if he were himself engaged, it is believed that the account will be read with greater intelligence, and be much better impressed on the mind. It should be added that in the use of such terms as anterior, external, or their English equivalents, in front, behind, outside, and so on, the strictly anatomical signification is preserved. As the body during the greater part of the examination lies on its back, there is a great temptation to depart from this, and call the anatomical anterior and posterior the upper and under, but confusion will only be avoided by adhering closely to the anatomical significations.

A report of the facts observed should always be dictated during the course of the post-mortem, and with the structures before you. This is a matter of very great importance, because, on the one hand, the facts may be otherwise forgotten, and on the other hand, the mere act of dictating a note induces one to make the observation much more accurate, and often suggests investigations which would otherwise be overlooked.

As the body lies on the table certain general appearances should first be observed and noted, such as the state of rigidity as determined by trying to bend the limbs; the evidences of decomposition ; the color of the surface, whether unduly pale or red or livid ; the presence or absence of œdema, any wounds or cicatrices. The general state of nutrition will also be observed, and, in connection with this, the comparative abundance of the subcutaneous fat as displayed by the first incision. In case of a medico-legal examination the body has to be identified by two persons whose names and connection with the deceased should be noted; the size, position, depth, and condition of any wound will also be carefully observed, and incisions will be judiciously made so as to display the wound thoroughly; or dissections will be undertaken so as to trace its relations to important structures. The examination of the surface of the body will not be confined in every case to its anterior aspect.

As the chest and abdomen are most frequently examined, we shall begin with them. A substantial block of wood is placed under the body so as to support the chest and increase the anterior convexity of the sternum. The knife being now grasped in the fist, an incision is made with a single sweep from the suprasternal notch to the symphysis pubis, deviating slightly in the abdomen to avoid the umbilicus.

CHEST.—Beginning in the chest the knife penetrates through the soft parts right down to the sternum, and on passing to the abdomen a similar depth is kept. In this first incision the abdominal cavity may perhaps be opened into, but if the knife has not penetrated so deeply the next procedure is to open it through the entire length of the incision in the abdomen. By dragging on the edge of the incision and cutting against the tightly drawn tissues, it is easy to lay open the cavity without cutting any of the subjacent viscera. This being done we have an incision extending in the middle line along the entire thorax and abdomen, and penetrating down to the sternum in the first part of its course, and afterwards through the peritoneum. If any fluid is present in the peritoneal cavity its quantity and character will be noted at this stage.

The next step is to reflect the soft parts from the anterior aspect of the thorax, and in this operation, as in many others, it is important to remember that if the tissues are dragged upon and thus rendered tense, they are much more easily divided than when lax. For this reason it is well to begin at the lower part of the thorax, because here the left hand may obtain a firm hold of the abdominal parietes and pull the tissues firmly outwards against the false ribs. By a few sweeping strokes against the tense tissues, the anterior wall of the thorax is exposed. It is to be observed that the soft parts should be reflected much further back at the lower part of the thorax than at the upper, in order fully to expose the cartilaginous ribs, which are longer below than above. Before dividing the cartilaginous ribs, it will be well for the beginner just to observe the line of junction of the cartilaginous and osseous ribs from above downwards. Beginning with the *second* rib the cartilages are to be divided just within the line of junction, and it will be seen that the incision tends very considerably outwards in passing down the thorax. In dividing the cartilages the edge of the cartilage-knife should be held flat against the thorax, so that before one cartilage is fully divided the knife will have caught on the next succeeding one. If this be attended to, the subjacent organs will not be injured. There still remain to be divided the first rib, and the sterno-clavicular articulation; the latter is often a stumbling block to beginners. The clavicle is united to the sternum and to the first rib by firm ligaments, and it is necessary to cut these through in order to free the anterior wall of the thorax. The head of the clavicle should be found, and a pointed knife (the cartilage-knife should have a triangular blade for this purpose), held perpendicularly to the surface of the body, is made to penetrate the joint immediately to the inner side of the head of the clavicle. It is then pushed downwards towards the thorax with a slight inclination outwards so as to divide the sterno-clavicular ligaments. It is afterwards worked round the head of the clavicle and carried outwards so as to divide the strong ligament between the clavicle and the first rib. If the position of those ligaments be studied in such a plate as that in Quain's Anatomy, the direction of the incisions will readily be gathered. The cartilage of the first rib is now to be divided, and this is best done by introducing the knife between the first and second ribs and cutting through the former right against the clavicle. It should be remembered that on account of the breadth of the manubrium sterni this cartilage is further out than the second. In this way the sternum and cartilaginous ribs are separated from all but soft attachments, and these have now to be divided. Seizing the lower cartilaginous ribs with the left hand and dragging sternum and cartilages forwards, the anterior attachments of the diaphragm are cut through, and then in succession all other attachments from below upwards, keeping close to the bone, especially at the upper part, so as to avoid wounding the large veins at the root of the neck. The condition of the ribs and sternum will be observed, before they are set aside. It is sometimes necessary to modify this procedure on account of the cartilages being calcified and almost like bone. In every case they should, if possible, be divided with the knife, and this method will rarely fail even though the cartilage be very hard. But sometimes it is necessary to saw through the cartilages, the other parts of the operation being the same as those already described.

The contents of the thorax are then exposed, and the general position of the edges of the lungs and of the pericardium and heart should be noticed. Before going further the contents of the pleural cavities should now be examined. The *pericardium* is then to be opened, and this may be done by taking hold of it with the left hand, pulling it till the tissue is tense, and then dividing it by an oblique incision so as not to incise the heart beneath. Normally there is a small quantity of fluid in the sac of the pericardium; any excess above three or four drachms will be noted. Before removing the *heart* from the body it is well to make incisions into its cavities in order to determine the quantity of blood in them. These incisions are made along the left and right borders of the heart respectively, and into its four cavities, the boundary line between the auricles and ventricles being spared. There will thus be four incisions, viz., into the left auricle, left ventricle, right auricle, and right ventricle, and the incisions will be longitudinal, passing in a direction from base to apex. In making the incisions the apex of the heart should be seized with the left hand, and dragged well forwards out of the body, so as to make the structures tense. After these incisions the fingers may be introduced into the cavities, and the contents approximately determined. The heart will then be removed. It should be seized by the apex and dragged well out of the body and towards the head, and the great vessels divided from below upwards. Before proceeding further the sufficiency of the aortic and pulmonary valves should be tested. These vessels should first be cleared of any adhering blood-clot, and then a stream of water poured into them at their cut extremities. The water should be poured from a height so as to pass in with some force. If the valves are competent then the vessels will be filled with the water and remain full. The closed valves may be observed from above through the water, but in order to do this it is sometimes necessary to cut the artery shorter, as the arch of the vessel may interfere with direct observation.

The general appearance and shape of the heart will now be observed. Normally it forms a blunt cone, and is nearly completely coated with a layer of adipose tissue under the pericardium, which is most abundant over the right ventricle.

The cavities of the heart are now to be laid open so as to expose the valves completely to view. The heart should be laid on a plate resting on its posterior surface just as it was lying in the body. The blunt blade of the gut scissors is then introduced into the right ventricle through the cut already made, and pushed upwards into the pulmonary artery. If the point be kept in the angle between the septum and anterior wall of the ventricle while it is pushed onwards, it will find its way into the pulmonary artery. Along this line the scissors are closed, and an incision made from apex to base, dividing ventricle and pulmonary artery. With the former incision this new one forms such an angle as to separate a triangular flap of ventricle. A similar method is followed on the left side. The blade is introduced at the former incision, and being held in the angle between septum and anterior wall, is carried out at the aorta. In completing this incision care is taken not to cut the left auricular appendage, on the one hand, or the pulmonary artery near its origin, on the other. The cavities being laid open the state of the valves will be observed, and any variation from the normal carefully regarded. The amount and kind of clot in the ventricles will be noticed, and so forth. The auricles are then more fully laid open by means of the probe-pointed scissors, and the contents observed. The auricular appendages should always be opened up because thrombi often lodge here. The capacity of the uriculo-ventricular orifices should now be roughly estimated, by introducing the fingers from the auricles. The mitral orifice normally admits two or three fingers, and the tricuspid three or four. After all clot has been removed, the heart should be weighed. The normal weight in the adult male is from 8 to 11 oz., and in the female 7 to 9 oz.

The *lungs* are now to be removed, and in order to do this they must first be freed from all pleural adhesions, if such exist. These adhesions may often be torn through with the fingers, but sometimes they are too firm for this. The adhesion is between the visceral and costal layers of the pleura, and it is sometimes easier to separate the costal pleura from the internal wall of the thorax than to tear through the adhesions. In order to do this an incision is made longitudinally along the internal aspect of the thorax, cutting against the ribs near their anterior extremities; the fingers are introduced behind the pleura, which is then torn off from the ribs. The lungs being freed, the apex of one is seized and pulled downwards so as to expose the root, which is then cut through, and the lung removed. By a similar procedure the other is taken out. The lungs being removed from the body, they are each in turn to be incised in such a manner as to expose their tissue thoroughly. Each is held by the root with the left hand, with its base resting on a wooden platter, and a cut made from apex to base along the most convex part of the surface, and carried down towards the root. The lung tissue is now examined, and, with the probe-pointed scissors, the bronchial tubes opened up so as to expose the mucous membrane to view.

The structures of the neck and what remains of the aorta have still to be examined. For this purpose, the original incision through the skin is continued upwards to the chin. The skin is reflected by sweeping strokes of the knife, so as to expose the structures of the neck. This being done, the knife is made to puncture the floor of the mouth from below near the middle line, and carried backwards along the jaw, first on one side then on the other, so as to separate the floor of the mouth. The fingers can then be introduced, and the tongue seized and dragged downwards. By pulling firmly on the tongue, the incisions can be readily carried backwards, and the knife divides the soft palate and then passes to the posterior wall of the pharynx. The whole structures are now separated from the bodies of the vertebræ, right down to the diaphragm, where the aorta and œeophagus are divided transversely. The parts being now laid with their anterior aspect downwards, the scissors are made to divide the pharynx and œsophagus along their posterior wall, then the larynx and trachea, also posteriorly, and lastly the arch of the aorta and its thoracic portion.

ABDOMEN.—We now proceed to the organs of the abdomen. The block which supported the thorax is removed, and the diaphragm is incised on either side so as to allow the abdominal organs to gravitate towards the thorax. In order to expose these organs fully, it is necessary first to separate the colon from its attachments, as it lies in front of some of the more important structures. The small intestine is pulled aside, and carried half out of the body, and then, beginning at the sigmoid flexure, the large gut is pulled forwards, while its attachments, thus rendered tense, are cut through. When the descending and transverse colon have been separated, it is often easier to pass to the caput cæcum, and take the ascending colon from below upwards. The large intestine being separated but not cut through, it is laid out of the body between the legs, being still attached at the rectum and ileum.

The position of the organs is now to be surveyed, and then the kidneys are to be examined. They should first be observed *in situ*, and any distension of the ureters or other alteration noted. The *supra-renal capsules* may be exposed at this stage, and they should be subsequently removed along with the kidneys. It should be remembered that the *kidney* lies behind the peritoneum, and the first step towards its removal is to cut through the peritoneum to its outer side. This being done, the fingers can now grasp the kidney and drag it forwards, and a few incisions will separate it with the supra-renal capsule from all attachments. The kidney is examined by holding it in the left hand with the hilus towards the palm, and then making an incision along the convex border, first through the capsule and then into the kidney substance down to the pelvis. The whole depth of the kidney tissue is thus exhibited, and the capsule may be separated so as to expose the surface by catching it at the edge of the cut and tearing it off. Before weighing the organ, the supra-renal capsule will be removed and examined, and the external fatty capsule disposed of. The normal weight of each kidney varies in the adult male from 4½ to 6 oz., and in the female from 4 to 5½ oz.

The *spleen* is easily removed by dragging it forward and cutting through the vessels. If it is laid on a plate, an incision along its convex surface towards the hilus will expose its tissue. The normal weight of this organ is extremely variable, and may fluctuate between 3 or 4 and 7 oz.

With a view to the examination of the *stomach* in situ, the gut scissors are first used to make an incision into the lower part of the duodenum. The long blade is then introduced at this incision, and the duodenum and stomach divided, the latter along its greater curvature. The mucous membrane of the stomach is examined by pulling the organ well forward, and laying it over the cut edges of the ribs. The papilla forming the orifice of the ductus communis will be observed in the duodenum, and the permeability of the ducts tested by forcing bile through them by squeezing the gall-bladder. If icterus be present, the ducts will be carefully traced upwards to the liver.

In medico-legal cases, where poisoning is suspected, particular care will be required in dealing with the stomach.

Before interfering with it in any way, ligatures should be applied just beyond the cardiac and pyloric orifices, and the stomach carefully removed entire. As a rule, it should be at once placed in a clean jar, and the jar covered with some water-proof material fixed with a string, of which the knot will be sealed with wax. A label will also be attached. If it is desirable to examine the contents of the stomach at once, the organ, after removal as above, should be opened on a clean plate, and all its contents carefully preserved. Stomach and contents will then be placed in a jar sealed and labelled as above. The duodenum should be preserved in a similar way, and afterwards the liver with the gall bladder and the urinary bladder, with their contents.

The *liver* will be removed by first cutting through the portal vessels, lifting the organ out of the body till it rests on the ribs, and then dividing the diaphragmatic attachments. It should now be laid with the portal surface downwards, and an incision made along its upper surface, including left and right lobes, down through the greater part of its thickness. Other incisions may be made from this one into the liver substance at various depths. The general appearance of the cut surface will be noted, as well as any irregularity of the capsule or external surface. The normal weight of the liver is in the adult male from 48 to 58 oz., and in the female from 40 to 50 oz.

INTESTINES.—The large intestine has been, so far, separated from its attachments (see p. 509); it is necessary now to remove the whole gut for examination. Beginning at the caput cæcum, the small intestine is to be separated by cutting through its mesenteric attachment. If the gut be pulled pretty firmly, then the knife, by a sawing motion, will readily and quickly divide the mesentery, which should be done close to the gut, so as to leave no mesentery on the gut. When the duodenum is reached, the gut is cut transversely. The rectum is now cut through at the lower end of the sigmoid flexure, and the whole gut removed and placed in a basin of water. The gut scissors are used to open the intestine. The longer blade is introduced at the upper end, and the intestine is pulled against the commissure of the blades, care being taken that it is the mesenteric border which is divided. It is seldom necessary to make frequent cuts with the scissors, the mere projection of the tissue against the fork being usually sufficient. When the colon is reached it is then necessary to cut with the scissors, as the coats are thicker, and there is no specially weak mesenteric border. When the whole length has been divided, the surface of the mucous membrane will be examined from above downwards, being passed under a stream of water so as to remove adhering mucus. The state of the vessels, the color and the condition of Peyer's patches, and the solitary glands, will be noted, as well as the existence of any pathological condition.

PELVIS.—The organs of the pelvis still remain. The bladder may be examined by dragging its anterior wall forwards, and making an incision in the middle line. The finger may be introduced into this incision, and the bladder pulled forwards, so as to expose the mucous membrane.

Taking hold with the left hand of the rectum behind, and the bladder in front, the whole contents of the pelvis may be scooped out with the knife. The rectum is now to be cut open with the gut scissors. In the case of the female, the probe-pointed scissors will be used to divide the vagina, and then the uterus. For this latter, the probe-pointed blade is passed into the cavity, and the incision carried along the lateral border, and then along the fundus, so as to expose the entire cavity of the uterus. The Fallopian tubes, ovaries, and ligaments will receive attention, and be incised if necessary. In the case of the male, the scrotum will be opened and the testicles examined, if thought necessary.

The viscera being removed, the aorta and its branches, as well as the venous stems, may be exposed and examined. Incisions will be made longitudinally into these vessels as required.

HEAD.—The examination of the head should be done at the very first if anything specially directs attention to the state of the brain; otherwise it may be done after the thorax and abdomen. A block is placed under the head, so as to support it as nearly as possible with the crown upwards. The soft parts are divided by an incision carried straight across the vertex from behind the one ear to behind the other. This incision should penetrate right down to the bone throughout. The entire soft parts are then reflected from the surface of the cranium by means of the chisel, the original incision having divided the scalp into two flaps. The bone is thus left bare, except at the sides, where the temporal muscles and the temporal fascia remain. These are removed by the aid of the knife, and a saw cut is carried round the calvarium on either side from a little below the supra-orbital ridge to an inch below the occipital protuberance. This cut should not penetrate through the entire thickness of the calvarium, but only the external table. In sawing, the left hand, which is used to steady the head, should be covered with a towel, so as to protect it if the saw slips.

To complete the separation, the chisel is inserted into the saw cut, and the internal table cracked through by a few smart taps with the mallet. The calvarium can then be forced off with the chisel. In cases of suspected fracture of the skull, it is well to saw through both tables, even at the risk of injuring the brain and its membranes; otherwise, the use of the chisel may extend an existing fracture, or even cause one. The surface of the dura mater is then to be examined, and the longitudinal sinus laid open by an incision in the middle line. The dura mater is now to be divided by one incision at the level of the saw cut all round, and by another dividing the tentorium between the hemispheres in front. The dura mater will be reflected from before backwards—the veins which enter the longitudinal sinus from the surface of the brain being cut through as progress is made. The pia mater of the convexity is now exposed, and its condition, as well as that of its vessels, observed. To remove the brain, the hemispheres are supported in the left hand, and the fingers of the right hand are insinuated in front of and under the frontal convolutions, lifting up with them the olfactory nerves. The other cerebral nerves are then cut through with a sharp knife at their points of exit from the skull, beginning with the optic. The tentorium cerebelli is divided along the posterior border of the petrous portion of the temporal bone, and then the knife being inserted into the foramen magnum, the medulla oblongata and the two vertebral arteries are divided as far down as possible. During all this operation, the brain is supported in the left hand, and, the principal connections being now divided, the right hand may be used to take hold of the base, and assist in gently raising the brain. The sinuses of the dura mater may now be opened in the base of the skull. If a fracture is to be looked for, the dura mater must be removed, and this is done by catching the edge where it has been cut, in the hand armed with a towel, and violently tearing it from the base. The orbit may be opened by removing its roof with the chisel and mallet, if it is thought necessary.

In the examination of the *brain* itself, the base should first receive attention. The arteries at the base should be carefully examined and partially traced into the fissure of Sylvius and the anterior longitudinal fissure, and on the surface of the cerebellum. The brain being now laid on its base, an incision is first to be made so as to open the lateral ventricle on the left side. For this purpose the hemispheres are separated, and a cut is made in a direction downwards and outwards, beginning at the outer border of the corpus callosum. The left hemisphere is so held in the left hand that, when the incision reaches the ventricle, the latter will gape and expose its cavity, which may then be more fully laid open. The lateral ventricle being fully exposed, its dimensions are noted, and any excess of fluid which may be present. It is now proper to explore and examine the hemisphere, which is done by a series of parallel cuts, which penetrate from the interior of the vetricle through the white substance outwards to the gray matter of the convolutions. The first of these incisions is almost a continuation of the cut which opened the ventricle, and is placed just outside the corpus striatum, which lies on the floor of the ventricle. The left hemisphere being thus explored, the brain is now wheeled round, and the right lateral ventricle and hemisphere are similarly dealt with. The brain being then brought back to its former position, the fornix and corpus callosum are divided anteriorly by an incision from the foramen of Monro outwards. These structures with the choroid plexus, and the pineal body, are observed, lifted backwards, and turned aside. If now the cerebellum be supported in the left hand, and an incision made through it in the middle line, the fourth ventricle will be opened. It is easy now to take a survey of the condition of the surface of the corpus striatum, optic thalamus, corpora quadrigemina, and floor of the fourth ventricle. While the cerebellum is in the hand, it may be incised by a series of cuts lying in the direction of the stem of the arbor vitæ, and extending through the substance of the cerebellum.

The *great ganglia* in the floor of the lateral ventricles have to be more fully examined. In order to this the left hand is introduced below the brain, so as to support these ganglia, and incisions are in succession made transversely through the corpus striatum and optic thalamus from before backwards, so as to divide them into a number of laminæ, first on the one side and then on the other. The crura, cerebri, corpora quadrigemina, pons Varolii, and medulla oblongata may also be divided by transverse incisions, so as to expose their tissue.

In this way the brain is examined, but it is not divided into little pieces. It is like a book whose binding is formed by the pia mater of the surface, and the locality of any discovered lesion can be readily determined.

In some cases it is important to examine the *organ of hearing*. To do this two coverging cuts are made with the saw, so as to include a part of the lateral wall of the skull and the petrous bone. If one of these cuts is just in front of the external auditory meatus, the membrana tympani will be easily reached afterwards. The tympanic cavity may be exposed by breaking through the thin plate of bone which forms its roof. The rest of the internal ear may be examined by means of the chisel or bone forceps, or saw. The mastoid cells may be exposed by sawing through the mastoid process.

SPINE.—If it be desirable to examine the *spinal cord*, then the vertebral canal should be opened before any other part of the body. An incision is made in the middle line behind from the occiput to the sacrum. The skin and muscles are reflected from the vertebræ, the arches of which should be well displayed. A block is placed under the body so as to make the vertebral column form a convexity posteriorly, and this block may be shifted upwards or downwards, according to circumstances. The arches of the vertebræ are sawn through a little to the inside of the articulations, or after sawing them partially the division is completed with the chisel or bone forceps. The arches being removed, the posterior aspect of the dura mater is exposed and its condition observed. The dura mater is then divided longitudinally along its posterior surface by means of the probe-pointed scissors, and the condition of the posterior surface of the cord and the soft membranes observed. The spinal nerves are then to be divided outside the dura mater as near as possible to their exits from the spinal canal, and the cord then removed, beginning with the cauda equina. In removing the cord it is well to take hold of the dura mater rather than the cord, which will otherwise get torn. The medulla oblongata will be cut transversely, and the cord thus removed from the body. The anterior aspect of the dura mater is now to be divided longitudinally, as was the posterior. Then the cord itself is examined by a series of transverse incisions, which ought to divide the cord completely, the separate pieces being held together by the spinal nerves and dura mater.

It is not necessary to give any special directions for the examination of the limbs. Incisions will be made so as to expose bones, joints, muscles, nerves, bloodvessels, &c., as they may be required.

EXAMINATONS IN PRIVATE HOUSES.—In addition to what has been said, it may be added that, while post-mortem examinations are most conveniently performed in rooms specially arranged for the purpose, yet it is often necessary to do them in private houses. In such cases the operator should, before beginning, see that everything likely to be required is present in the room. It is important to have a sufficient supply of water and various vessels. There should be two or three basins, a pail into which any blood or bloody fluid can be poured, and one or two jugs or ewers full of water. Several towels should be supplied, and some old cotton cloth which can be used for cleansing or for protecting the carpet and articles of furniture from being soiled. A sponge is also very useful.

STRUCTURES REMOVED FOR DETAILED EXAMINATION.—In some cases it may be advisable to remove portions of organs for more detailed examination afterwards, or in order to submit them to a more skilled observer. When possible such structures should first be examined in as fresh a state as possible,.and if the examination cannot be done on the spot, the structure should be carefully placed in gutta-percha tissue or other waterproof, and so packed as to prevent evaporation and avoid pressure. If it be desired to preserve parts for minute microscopic investigation, they may be hardened in alcohol or solutions of chromic acid or the chromates. In any case, but especially when chromic acid is the fluid used, the structure should be cut into small pieces, and the fluid should be so abundant that no two pieces can lie in contact. This is very specially to be observed in the case of the brain and spinal cord. The pieces in this case should not be larger than the terminal joint of the finger, and it is well to leave them for twenty-four hours in alcohol before placing them in solution of chromic acid. When it is proposed to submit these parts to more skilled investigation they should be forwarded at once, and in the alcohol, the further process of hardening being left to the individual investigator.

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